ERIC Document Resume | See Instruction Sheet | DATE OF RESUME 9/18/65 | DATE RECEIVED

A. PUBLICATION DATA

1. ERIC NUMBER ED002345
2. ORIGINATOR CONTROL NO(S). N.A.
3. IDENTIFICATION NO. N.A.

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MICROFILM COPY AVAILABLE YES ☒ NO ☐

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TYPE OF REPORT
PROPOSAL ☐
IN-PROGRESS ☒
FINAL ☐
FOLLOW-UP ☐

OTHER ERIC REFERENCES:

ERIC SATELLITE CODE

4. AUTHOR(S): Twyford, Loran C., Jr. and others

5. TITLE OF DOCUMENT ABSTRACTED: New Media Studies for Improvement of Science and Mathematics Instruction

6. PUBLICATION TITLE: N.A.

7. EDITOR(S): N.A.

8. PLACE OF ORIGIN
ORG. The State Education Department
ST. Albany, New York
CITY, STATE
TELE. EXT.
INST/LOC CODE

9. PUBLISHER OR SOURCE The University of the State of New York, The State Education Department, Albany, New York

10. VOL.	11. PAGES	12. MO./YR.	13. TOTAL PP.
N.A.	N.A.	6/64	127

B. INDEXING DATA

14. SUBJECT AREA

15. TYPE OF ENDEAVOR Experimental Study

16. INDEXING TERMS (6-12)

	teaching methods	ninth grade science
lecture method	general science	homework
independent study	audiovisual instruction	evaluation and testing
closed circuit television	junior high school	

17. ABSTRACT (MAX. 250 WORDS)

Studies on ninth grade general science and mathematics are included: (1)"A Comparison of the Relative Effectiveness of Four Methods of Teaching Ninth Grade General Science," by Ralph Smith and Hildreth H. McAshan. Methods employed are normal instruction, teacher lecture, independent directed study, and independent directed study plus teacher lecture. The three experimental methods were as effective as the normal method, with the lecture method considered best.

(2) "Study of New Media Suggestions for Improving Televised Science Instruction," by Catherine M. Bailey and Hildreth H. McAshan. Data revealed no significant learning increases in experimental groups involving improved instruction, closed circuit instruction plus classwork, and closed circuit television for entire class periods.

(3) "Study of Transferability of Suggestions for Improvement of Science Instruction," by Sharon W. Miller and Robert M. Brown. Teacher interviews revealed general approval of the suggestions for improving instruction.

(4) "Development of a Method for Measuring Sources of Learning," by Sharon W. Miller and Robert M. Brown. Most of the learning was derived from the teacher's presentation.

(5) "Method for Increasing Learning, Utilizing Learning Profile Findings," by John G. Church, Sharon W. Miller, and Robert M. Brown. The new media are more useful in teaching a greater amount of material than in teaching a specified amount better.

ERIC No. 18. SOURCE OF ABSTRACT

C. FUNDING DATA

19. SUPPORTING ORGANIZATION

20. DIVISION OR DEPT.

21. CONTRACT NO.

PROJECT NO.

22. TOTAL COST OF PROJECT

23. DURATION OR PROJECT

U.S. Department of Health, Education, and Welfare
Office of Education

ED002345

new media studies for improvement of science and mathematics instruction

REPORT OF A STUDY SUPPORTED IN PART BY
A GRANT FROM THE OFFICE OF EDUCATION,
U. S. DEPARTMENT OF HEALTH, EDUCATION
AND WELFARE, UNDER TITLE VII OF THE
NATIONAL DEFENSE EDUCATION ACT OF 1958.

The University of the State of New York
The State Education Department
Bureau of Classroom Communications

U. S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
Office of Education

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NEW MEDIA STUDIES FOR IMPROVEMENT OF SCIENCE AND MATHEMATICS INSTRUCTION

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The studies reported herein were supported in part by Grant No. 7-30-044.00 from the United States Office of Education, Department of Health, Education and Welfare.

The University of the State of New York
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June 1964

ED002345

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INTRODUCTION

This publication contains five studies of the new media as applied to the general problem of improvement of science and mathematics instruction. These studies supplemented two basic studies. They are titled:

1. New Media for Improvement of Science Instruction by Loran C. Twyford, John G. Church, Hildreth H. McAshan and Robert Brown.
2. New Media for Improvement of Algebra Instruction by John G. Church, Robert M. Brown, Loran C. Twyford.

Taken as a whole, these studies provide information on the important sources of learning in which new media are employed. This series of studies points to ways in which not only significant increases in learning may be brought about but also how much larger increases may be attained.

ACKNOWLEDGEMENTS

So many persons have been associated with this series of studies that it is nearly impossible to name all those who have been involved. The authors would like to express their appreciation realizing that without their splendid cooperation this research could not have been carried out.

The producers of educational communications materials and equipment deserve special mention for making materials available for the two major studies as well as for the five reported herein. The materials that were used have been listed as footnotes in the science and algebra studies.

Appreciation is expressed to Joseph Lev who very materially assisted in the statistical analyses for these five studies. The numerous graduate assistants who worked on the project performed an invaluable service in carrying out the special tasks involved in a project of this complexity.

LIST OF STUDIES

Page

1. A COMPARISON OF THE RELATIVE EFFECTIVENESS OF FOUR METHODS OF TEACHING NINTH GRADE GENERAL SCIENCE.
Ralph Smith, Hildreth H. McAshan 1

2. STUDY OF NEW MEDIA SUGGESTIONS FOR IMPROVING TELEVISED SCIENCE INSTRUCTION.
Catherine M. Bailey, Hildreth H. McAshan 37

3. STUDY OF TRANSFERABILITY OF SUGGESTIONS FOR IMPROVEMENT OF SCIENCE INSTRUCTION.
Sharon W. Miller, Robert M. Brown 61

4. DEVELOPMENT OF A METHOD FOR MEASURING SOURCES OF LEARNING
Sharon W. Miller, Robert M. Brown 87

5. METHOD FOR INCREASING LEARNING UTILIZING LEARNING PROFILE FINDINGS.
John G. Church, Sharon W. Miller, Robert M. Brown 101

A COMPARISON OF THE RELATIVE EFFECTIVENESS OF FOUR METHODS OF TEACHING NINTH GRADE GENERAL SCIENCE

Ralph Smith
Hildreth H. McAshan

The study reported herein was supported in part by grant No. 7-30-044.00 from the United States Office of Education, Department of Health, Education and Welfare.

The University of the State of New York
The State Education Department
Bureau of Classroom Communications

June 1964

Table of Contents

Page

FOREWORD 3

Summary Abstract 5

Importance of the Study 6

Literature on Methods of Instruction 7

Purpose of Study 9

METHOD 11

- Experimental design 11
- Group I - Normal instruction method 12
- Group II - Teacher lecture method 12
- Group III - Independent directed study method 12
- Group IV - Independent directed study plus teacher lecture method 13
- Subjects 14
- Materials used 17
- Procedures 19
- Analysis of data 21

SUMMARY OF RESULTS AND CONCLUSIONS 29

DISCUSSION 33

APPENDIX A 34

APPENDIX B 35

BIBLIOGRAPHY 36

FOREWORD

This research was a supporting study under a grant for the study of the use of the new media for the improvement of science and mathematics instruction. Soon after beginning the study of the introduction of new media into science instruction it became apparent that it was not going to be possible to bring about a large increase in learning. An increase of ten percent might be significant but it should be possible to achieve much larger gains if educational media were used to maximum advantage. Why were we not able to achieve these much greater increases?

One reason why learning might not increase rapidly when the new media are used in the classroom could be because most of the learning results from outside class activities such as homework. In this study some significant information was obtained on the possible sources of learning.

Appreciation is extended to the Central Park Junior High School, Schenectady, New York for their assistance in the conduct of the research.

This study is primarily of interest to investigators of instructional methods involving independent study. It is also of interest to those studying ways to improve classroom learning since it gives some indication of major sources of learning.

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A COMPARISON OF THE RELATIVE EFFECTIVENESS OF FOUR METHODS OF TEACHING NINTH GRADE GENERAL SCIENCE*

Ralph Smith
Hildreth H. McAshan

Summary Abstract

Four methods were employed to teach a ninth grade unit in general science. The normal instructional method was compared with a teacher lecture method, an independent directed study method, and an independent study plus teacher lecture method. The normal method employed the lecture and homework. The lecture method involved note taking but no outside reading was permitted. The independent study group used study guides and library materials but no lectures were given. The fourth group used study guides and library materials and had lectures by the teacher. A test was given after three weeks of study of a unit on nuclear energy. The three experimental methods were at least as effective as the normal method of instruction and the lecture only method was significantly better than all. These findings suggest that independent study methods may be employed more widely in view of their demonstrated effectiveness. It is difficult to understand why the method utilizing the assignment of homework plus lecture was so much less effective than the lecture only method.

Learning the content of a course of instruction is not usually completely dependent upon what the teacher says and does in the classroom. Additional learning occurs from homework assignments, text readings and from student discussions and other outside sources. How effective are these other sources of learning and how effective might they be? This study compares four effective means for learning course content. The findings give some indication of the value of classroom instruction and the potentiality for improving instruction through classroom instructional innovations.

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*This research was supported in part by Grant No. 7-30-044.00 from the United States Office of Education, Department of Health, Education and Welfare. The principal investigator was Loran C. Twyford. Ralph Smith was responsible for conducting the research study. Hildreth McAshan assisted with the project formulation and statistical analysis.

Importance of the study

Better understanding and learning of subject matter information may best be accomplished by improvement in the major source of learning. Conversely, not much improvement can be expected if the primary focus of improvement is relegated to only minor learning sources. The normal method of instruction in ninth grade general science classes may include readings from a text or texts, lecture, visualization of certain processes, and experimentation by teacher, student, or both. It may be that one or more of these component entities adds little or nothing to the immediate or retained learning of the students and that the time consumed in that phase of study might more profitably be applied to another phase.

If, for example, it is found that normal class instruction on factual materials results in a contribution of fifteen percent or less, of the total learning of the students, the teacher may find it more advantageous to devote the bulk of his time and effort to development and direction of a program designed to teach practical application of information which the students learn through directed study outside of class. Educationally speaking, we need to find answers to the following questions:

1. What percent of general science information is learned by students outside of classroom presentations?

2. What percent of general science information is learned by students from classroom presentations?

3. What is the maximum contribution which may be expected from the teacher?

4. Upon what theory or premise should a teacher base her classroom activity?

5. How may a student best spend the time presently allocated to classroom activity?

6. Can ninth grade students be adequately motivated to carry on independent directed study?

Literature on methods of instruction

Recent research indicates a growing awareness of value of individual guided study. A. W. Vander Meer, (1) working with ninth grade students, found that "where the task is to impart a specific body of factual information a course of carefully produced films covering this information would result in as effective learning as a training course led by instructors using conventional methods." He warned, however, that after covering two units of study students began taking a "cavalier attitude" toward study guides and that additional motivational materials and practices had to be introduced. J. D. Scott (2) applied with significant success, a technique termed the "inductive method" of teaching whereby students were encouraged through independent study without texts to discover relations between data in order to arrive at their own generalizations. He found also that boys showed more increase in learning than girls.

Boeck, (3) in a study very closely related to the problem at hand, found nonsignificant differences between three methods of instruction. Specifically, his study compared the achievements of general science pupils: (1) who only read and discussed prepared materials; (2) who did no reading but were given demonstrations with discussion of the same materials; and (3) who were taught by a combination of these methods. The reading method, (4), Boeck found, was rated low by students, indicating the necessity for constant extrinsic motivation or development of means of instilling intrinsic motivation, perhaps as illustrated by the above-mentioned study by Scott. Allison and Ash (4) found that a mild degree of situational anxiety, created by advising students that they are expected to learn and that they will be tested on the material to be presented, increases the amount of learning achieved and may be considered motivational.

As has been noted by many researchers, comparisons of lecture versus recitation or laboratory versus discussion are essentially impossible since each methodology is subject to broad and diverse interpretation and description, and since, even if definitive limitations could be universally established, each would prove meritorious under certain conditions. Decisions concerning methodology, then, should be based upon the specific desired objectives. In summarizing the merits of various experiments involving methodology Wingo (2 p. 851) comments:

> Further study of the methodology of teaching--including the relative merits of the lecture method--will be enhanced if investigators will relate objectives to method and study the efficacy of a method in terms of the type of objectives sought.

As early as 1928, Greene (5) compared lecture method to reading method, finding insignificant differences in mean scores. Birney and McKeachie, (6) reviewing research completed between 1942 and 1955 found no single system universally superior. The value of various methods they found, appeared dependent on objectives of courses and the degree of perfection of the method used.

Dale and Raths (7) found that the prevailing method in the two hundred classrooms they investigated was the recital method, with memorization of textbook subject matter the main objective. In a survey of teaching procedures in thirty-eight school systems in five midwestern states, Feany (8) noted that the same objective predominated. Commenting on the apparent inconsistencies of methods and objectives, Smith and Anderson (2 p. 1224) state:

> Considering the rather enormous sum of money which is invested in science textbooks and workbooks each year by students, parents, and school districts, it is indeed amazing that so little research relating to textbooks and workbooks has been reported....There is a great volume of opinion and a general condemnation of the so-called "textbook method." Perhaps such an attitude has served to prevent legitimate inquiry as to the appropriate role of textbooks and workbooks in science classrooms.

Purpose of study

The purpose of the study was to determine the relative effectiveness of four instructional methods for learning factual information in a ninth grade general science course. The effectiveness of a lectures only method was compared with the normal instructional method. Students working on their own (in an independent study method) was also compared with the normal method. The fourth method involved both lecture and independent study and was compared with the normal method. From these comparisons it was desired to discover how much each source of learning might contribute to total learning by the student.

In more specific terms the hypotheses to be tested were stated in the following form:

1. Eighty-five percent of what is presently achieved by general science students may be accomplished in self study. Through normal classroom presentation the teacher contributes less than 15% of all measurable student achievement.

2. **There is no difference in the achievement of ninth grade science students who have received instruction through normal classroom procedures and of ninth grade science students who do not use textbooks for outside of classroom study. (Groups I and II)**

3. **There is no difference in the achievement of ninth grade science students who have received instruction through normal classroom procedures and of ninth grade science students who study primarily from text assignment both outside and inside the classroom. (Groups I and III)**

4. **There is no difference in the achievement of ninth grade science students who have studied the text assignment at home and have been taught non-text material in class and of ninth grade science students who have studied the text only or who have received instruction by a teacher's normal classroom presentation. (Groups I, III and IV)**

METHOD

Experimental design

A matched group technique was used to determine what changes among the sample population could be attributed to the effects of the specific methods employed. This procedure was carefully devised so as to eliminate bias in outcomes and confusion in interpretation.

A unit test was developed to evaluate students' acquisition of certain selected factual materials. The test was administered to the sample subjects in such a way that no subjects were required to take it more than one time. One group of students, the control-control group, did take it twice to aid the investigators in establishing the level of prior knowledge, but the students involved were not considered subjects for statistical purposes.

Four methods of instruction were used and evaluated as to their efficacy in teaching the students a specific body of factual information and generalizations. The four methods were:

1. The normal instruction method, (Group I)
2. The teacher lecture method, (Group II)
3. The independent directed study method, (Group III)
4. The independent directed study plus teacher lecture method, (Group IV).

Two teachers, both regularly employed by the participating school, took part in the study. Teacher A, who taught four classes of ninth grade general science daily, was assigned one of each of the control and experimental methods, and teacher B, who taught two classes daily, was assigned one control (Group I) and one experimental (Group III) class. Each teacher conducted the classes according to the criteria described below.

Group I - Normal instruction method

The students taught by the normal instruction method were classified as "Group I." Each of the two teachers taught one Group I class. The teachers were instructed not to alter their normal procedures in any way. Following the completion of the experimental unit of study, each teacher submitted estimates of the daily allocation of time to various study techniques used in the Group I classes. They also listed all visual aids and supplemental literature utilized. It was essential to the design of this study that no controls be exercised over the control classes. The estimates made by the teachers are considered adequate descriptions of the control group criteria.

Group II - Teacher lecture method

Teacher A taught one Group II class by presenting all the materials covered in the unit of study by the lecture method. Subjects in this class were allowed to take notes on lecture material, but no texts or supplemental reading assignments were made or allowed. Since the school operated on the multiple-text basis, the subjects had no texts issued during the course of this unit of study. The teacher's lecture consumed the entire daily lesson period.

Group III - Independent directed study method

Two classes of Group III students met daily, and were taught by each of the participating teachers. Students in this group were given study guides (Appendix A) which directed them through a series of activities designed to expose them systematically to all of the materials pertinent to the unit of study. Students were allowed to proceed at their individual rates of speed and encouraged to read supplementary materials available in the library. The study guides were constructed in such a way as to require students to seek information from reading assignments in order to fill in blank spaces in study guide materials. Specific references were given to guide the students to readings containing required answers. Study guides of each student were checked individually during class time by the teachers. The teachers noted errors and omissions and directed students to proper reference materials but did not supply answers directly.

Group IV - Independent directed study plus teacher lecture method

Students assigned to the Group IV, independent directed study plus teacher lecture classes, were given copies of the same study guide used in the Group III classes. Students in the Group IV class, taught by teacher A, were advised that approximately one-half of each class period would be devoted to individual work with study guides and the remaining class time devoted to teacher lecture. The students were directed to work regularly with study guides outside the class hours. Lectures given by the teacher were based on materials directly related to textbook and study guide topics. The teacher was instructed to avoid repeating facts covered by independent study materials and to try, instead, to prepare his lecture on the theory that such information had already been acquired by the students. Weekly quizzes were administered to all groups. The quizzes were considered motivational only and results were not considered in the statistical analysis.

Achievement tests, based on questions submitted by the teachers, were administered to all students at the completion of the unit of study. Each

Thursday, a twenty to thirty-minute period was designated for review and student questions. During the review sessions teachers of Group I and Group II classes were free to conduct open discussions while in Group III and IV classes teacher participation was limited to clarification of ideas submitted by students, aiding students in gaining knowledge of correct pronunciation of new vocabulary terms, and offering specific references in reading materials in response to student questions.

Figure I presents the experimental design in outline form.

Subjects

The matched groups for this study were drawn from a population of ninth grade science students at the Central Park Junior High School, Schenectady, New York. Prior to the beginning of this study the school administration had formed six classes of general science by random assignment of students assumed to be of average ability. The population sample consisted of approximately one hundred eighty eight male and female ninth grade students enrolled in a general science course during the spring term of the school year 1960-61. The mean number of students per class was 31.33, and the range of students per class was twenty six to thirty six.

The matched groups used in the statistical analysis comprised the entire population of the smallest class, (26 students), and twenty six students from each of the five other classes. These one hundred fifty six were designated, "subjects," and their final examination scores were evaluated statistically.

EXPERIMENTAL DESIGN

	Normal Instruction Method Group I Control Group	Teacher Lecture Method Group II Experimental	Independent Directed Study Method Group III Experimental	Independent Directed Study Method Group IV Experimental
1.	Classes were conducted in method normally utilized by both teachers. * (a)	Classes encouraged to take notes and to question teacher in class. No readings allowed or assigned. (a)	Classes used teacher prepared study guides and read supplementary materials in class and library - no lectures. (a)	Classes used teacher prepared study guides and read supplementary materials in class and library - with lectures. (a)
2.	Weekly quiz (b)	Weekly quiz (b)	Weekly quiz (b)	Weekly quiz (b)
3.	Weekly review and student question sessions.	Weekly review and student question sessions.	Weekly review and student question sessions. Teachers supplied concise answers to direct questions and referred students to reading materials.	Weekly review and student question sessions. Teachers supplied concise answers to direct questions and referred students to reading materials.
4.	Unit test made up of teachers' questions on unit material.	Unit test made up of teachers' questions on unit material.	Unit test made up of teachers' questions on unit material.	Unit test made up of teachers' questions on unit material.
5.	Analysis of data.	Analysis of data.	Analysis of data.	Analysis of data.

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*

[a] A number of the students in the class took the unit test as a pretest on material to be presented in the unit of study and were designated as the Control-Control Group. The results of this group were not included in the statistical analysis.

[b] Weekly quizzes were considered motivational in nature and were not considered in comparisons of achievement.

Figure I

The remaining members of each class were administered the final unit test as a pre-test, prior to the first class meeting. During the course of the study these students, hereafter referred to as the "Control-Control Group," took instruction with the classes to which they were originally assigned. The results of the pre-test were used as an aid in establishing the effect of prior knowledge and the chance factor on the unit test. The Control-Control Group students took the final unit test again at the close of the unit of instruction but their results were not considered in the statistical analysis.

To assure random assignment of students as experimental subjects, students in each class were given numerical designations. Numbered slips were placed in a container and were drawn and returned to the container until twenty six different numbers were recorded for each class. Those students represented by the remaining slips were designated members of the control-control pre-test group.

To assure random assignment of teaching methods to classes, two containers were used. One held six slips on which methods were designated, the second held six slips each representing one of the six general science classes. Slips were drawn alternately from each container and matched to one-another. Schedule A shows the results of this assignment.

Daily Experimental Class Positions
Recording to Teacher

The random assignment of methods of instruction resulted in the schedule shown below.

Teacher	Period I	Period 2	Period 3	Period 4	Period 5
A	Group I		Group IV	Group III	Group II
B	Group III		Group I		

SCHEDULE A

Materials used

All the materials used in this study were either readily available to the participating school or were created by participating teachers.

1. Textbooks. The participating school operated on a multiple text basis. There were not enough copies of any single text to equip the entire class, so students were required to read material from several texts for each unit of study. All text books were kept in the general science classrooms and were available to students on a check-out basis for home use. A complete list of textbooks is found on Appendix B.

2. Films and filmstrips. The films and filmstrips used were requisitioned by the teachers through the regular channels of the Schenectady Board of Education.

3. Audio-visual equipment. The film projector, screen, filmstrip projector, and overhead projector used in the study were supplied by the school.

4. Supplementary reading materials. Pamphlets and brochures were acquired free of charge from several sources.

5. Study guides. For those students in the independent guided study classes, (Group III) and the independent guided study plus lecture classes, (Group IV), a complete outline of activities was drawn up by the participating teachers. This outline, hereafter referred to as "study guide," directed each student through a series of text and supplemental readings and contained step-by-step instructions to guide students, through daily

classroom activities. Using the study guide, each student proceeded through a carefully planned series of activities including reading, filling in answers to questions contained in the study guide, defining terms, creating drawings of pertinent machines and materials, labeling diagrams, identifying people, places, and procedures, completing matching and completion quizzes, and writing generalizations inferred from the facts presented in reading materials. The study guides were so designed as to allow each student to proceed at his own rate, without assistance from any source.

6. Achievement test. The measuring device used to evaluate student progress was an achievement test constructed by the participating teachers. To assure statistical comparability, the same test was administered to all students. To avoid weighting the test in favor of any single group or source of information, each teacher submitted sixty seven questions to the investigator. The teachers attempted to draw questions from each of the various sources of information used in the study. From the questions submitted by each teacher, the investigator selected twenty four which were common to both lists. After the selection had been completed both teachers examined the list and indicated that they felt all questions were valid and acceptable for all classes. In its final form, the achievement test consisted of thirty nine, four-part multiple choice questions, two short essays, and eleven completion questions. Before the test was administered to any students, all questions were checked for accuracy and appropriateness by staff members of the New York State Education Department. This resulted in several minor changes in wording and terminology. The test was once again submitted to, and approved by the teachers before administration to students.

Procedures

For several weeks prior to the first meeting of the experimental classes, the investigator met regularly with the participating teachers and with the administrators of the participating school. During these meetings, the teachers were given detailed instructions regarding application of the three experimental teaching methods. It was decided that the most feasible way to measure the efficacy of any one of the various teaching methods utilized in the normal classroom was to measure each one individually. Both teachers agreed to cooperate fully with the investigator and to make every effort to avoid contamination of results. They developed outlines for each of their classes covering all of their classroom activities for the unit of study. The investigator checked the outlines and found no proposed activities which might be inconsistent with the experimental design.

Several preliminary meetings were devoted to discussion and development of study guides used in Group III and IV classes. During these meetings, specific subject matter objectives were decided upon and their objectives served as guides in study guide construction. Both teachers submitted rough drafts which were evaluated jointly by teachers and investigators. The finished study guide, created as a result of these meetings, was used in all the Group III and IV classes.

Additional copies of pamphlets and brochures containing supplementary readings were requested and received prior to the first class meeting. These materials were acquired at no cost from various business and publishing firms.

At the first meeting of each experimental section the students were advised as to procedure which would be followed for the unit of study and study guides were distributed in appropriate sections. Since it had been the practice of both teachers to initiate each new unit with a brief oral introduction designed to stimulate interest, and since their introduction contained no materials which might contaminate the findings of the study, it was decided to adhere to this policy.

On Friday of each of the first two weeks of the study, quizzes were administered to each section. Results of quizzes were not considered statistically and were solely motivational. At no point during the term did the teachers state or intimate that an experiment, as such, was being conducted. Every effort was made to avoid the possibility of the students considering themselves as "guinea pigs." Students in experimental classes III and IV were encouraged to seek assistance from the teacher in completing study assignments; teacher assistance was limited to advising students of errors and directing them to proper source materials from which correct responses could be drawn.

Throughout the three-week unit of study the participating teachers made every effort to adhere to the specific practices outlined for each control and experimental group. At the end of the unit of study, the achievement test was administered to each student in every class.

Analysis of data was made following the testing of the control and experimental groups.

Analysis of data

Data was obtained from one hundred seventy three persons who took the achievement test. Of this group of students, 32 were in the Control-Control Group used for pre-test purposes of establishing prior knowledge and the chance factor of answering the exam questions; 50 were in the Control Group I taught by conventional methods; 22 were in Experimental Group II instructed by teacher lecture only; 46 were in Experimental Group III who studied independently by using study guides; and 23 were in Experimental Group IV who studied the test independently and were presented non-text lectures in class.

I. Results of the test of hypothesis one.

Hypothesis one states, in essence, that the independent directed study method (Group III) would be at least eighty five percent as effective in preparing students for the unit test, as would the normal classroom method (Group I). While the analysis of variance showed no significant difference in the mean scores, it did not allow for an evaluation according to hypothesis I. To test this hypothesis, unit test raw scores were converted to percentage figures, one hundred percent representing the highest possible raw score, zero percent representing the lowest possible raw score. This conversion resulted in mean scores shown in Table I.

Because these figures dealt with percents based on total possible scores and did not take into consideration the results of the pre-test findings, further conversions were made. A pre-test mean of 35% was used as

COMPARISONS OF MEANS - GROUP I AND GROUP III CLASSES

GROUP	MEAN SCORE (%)	Difference in %
IA	74.6	- 4.7
IIIA	69.9 >	
IB	74.3 >	
IIIB	73.9	- .4
IA) IB)	74.3 >	
IIIA) IIIB)	71.9	- 2.4

Table I

a base for the second evaluation. Using this base allowed for evaluation of net learning, only, for in each comparison the mean score of the control group represented 100%. Table 2 shows the results of these comparisons.

COMPARISONS OF NET LEARNING SCORES

GROUP	MEAN SCORE (%)	Difference in %
IA	100 >	
IIIA	85.6	- 14.4
IB	100	
IIIB	100.5 >	+ .5
IA) IB)	100 >	
IIIA) IIIB)	95.4	- 4.6

Table 2

In no case was the difference in net learning greater than 15%, the limits set in hypothesis one. Hypothesis one is, therefore, accepted.

II. Results of the tests of hypotheses two, three and four.

Hypotheses two, three, and four were stated separately to allow acceptance or rejection of either hypothesis independently from the other two. However, collectively they state that there is no difference in the achievement of ninth grade science students who have received instruction through conventional methods or procedures and of ninth grade science students who (1) receive lectures with no textbook assignment, (2) study independently from text and miscellaneous materials with no teacher lecture, and (3) study independently from the text and receive supplemental non-text lectures in class.

These three hypotheses seek to determine if the means of the correct answers for individuals in Control and Experimental Groups II, III and IV are equal. All groups used the same test; therefore, the individual scores made by the students were used in the statistical analysis.

Since two teachers were used in the experiment, comparisons were made both individually and collectively. The first teacher taught four groups with four methods and these classes were named "A" groups. The two classes taught by the second teacher were referred to as the "B" groups.

(a) Comparisons using "A" groups.

Table III compares the experimental and control groups with respect to number in the group and mean scores of the unit test.

TABLE III

MEAN COMPARISONS OF FOUR METHODS OF INSTRUCTION

Method	N	Mean of Unit Test
I	26	74.65
II	22	90.55
III	25	69.92
IV	23	74.65
All methods	96	77.06

In the pre-planning stage of the experiment, it was decided that the analysis of variance could most effectively establish the significance of the differences, if any, which might occur in the group means. The results of this analysis are revealed in Table IV.

TABLE IV

ANALYSIS OF VARIANCE OF FOUR METHODS USED WITH "A" GROUPS

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Among methods	5,557	3	1,852	3.76*
Error	45,361	92	493	

*Significant at .05 level.

The F value, as is shown above, suggests that the general hypothesis which stated that the means of the four methods would be found equal must be rejected. In other words, the four methods of instruction by this teacher may not be regarded as equally effective. The mean of method II is revealed as being significantly higher than I, III, and IV.

However, since the means for methods I, III, and IV are nearly equal, an analysis of variance was suggested which excluded method II. The following results in Table V were obtained from this analysis:

TABLE V

ANALYSIS OF VARIANCE OF METHODS I, III, IV

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Methods	360	2	180	.49
Error	40,384	71	569	

In this analysis an extremely low value of F (.49) was obtained which indicates that the means were not significantly different. Therefore, data was obtained which allowed the researchers to assume that the three methods of instruction obtained equal results.

In summing up the two analyses performed for the"A" groups we find that method II (lecture only) is more effective than the remaining three, and that methods I, III, and IV are equally effective. This conclusion was further confirmed by separate comparisons of the pairs II with I, II with III, and II with IV.

(b) Comparisons using "B" groups.

The mean percent of correct answers for the 24 individuals using Method I was 73.92. The mean precent of correct answers for 21 individuals using Method III was 74.333. Table VI gives data obtained from the analysis of these two groups.

TABLE VI

ANALYSIS OF VARIANCE OF TWO METHODS

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Methods	3	1	3	.008
Error	15,674	41	382	

As was the case in I, III, and IV comparisons of "A" group, the low F value suggests that both of these two "B" methods are equally effective.

(c) Comparisons of "A" and "B" groups combined.

Table VII represents means of the combined scores of the "A" and "B" groups.

TABLE VII

COMPARISONS OF THE FOUR METHODS COMBINED

Method	N	Mean of Unit Test
Group I (A & B)	50	74.300
Group II	22	90.545
Group III (A & B)	46	71.935
Group IV	23	74.652

Again the analysis of variance was applied and revealed the results as listed in Table VIII.

TABLE VIII
ANALYSIS OF VARIANCE OF FOUR METHODS COMBINED

Source of Variation	Sum of Squares	D. F.	Mean Square	F
Methods	5,600	3	1,867	4.18*
Error	61,261	137	447	

*Significant at 1 percent level.

The high F value listed above means that the null hypothesis concerning equality of the four methods of instruction must be rejected due to the apparent superiority of Method II (lecture).

In order to double check the significance of the above finding, the I. Q. scores were obtained for all members of the four groups. This was to further determine whether or not the subjects were as closely matched as would be expected in random assignment to groups. Table IX shows the arrangement of matched groups, number in groups, mean unit scores, and the mean of the California Mental Maturity I.Q. test.

TABLE IX
DATA FOR COVARIANCE ANALYSIS OF ALL GROUPS

Methods	N	Unit Test Mean Score	Cal. M.M. I.Q. Mean Score
Group I A & B	50	74.300	98.34
Group II A	22	90.545	108.82
Group III A & B	46	71.935	102.43
Group IV A	23	74.652	97.26

The data in Table IX clearly indicated that further analyses was necessary due to the superior I.Q. scores of Group II. This was accomplished by an Analysis of Covariance using I.Q. as the concomitant variable. Table X gives the result of this analysis.

TABLE X

ANALYSIS OF COVARIANCE OF FOUR METHODS

Source of Variation	Sum of Squares	D. F.	Mean Square	F
Methods	2,894	3	960	3.34*
Error	39,258	136	289	

*Significant at 5 percent level.

The analysis of covariance indicated that the greater average intelligence of Group II in comparison with the other groups did influence the unit test means, since the new F value obtained is less than in the analysis of variance. Nevertheless, the significance of F obtained in the analysis of covariance suggests that the methods still differ at the 5% level even after differences in intelligence have been eliminated. As was previously stated methods I, III, IV using both groups A and B combined show no difference in effectiveness.

SUMMARY OF RESULTS AND CONCLUSIONS

The results of this study indicate that, within the limits imposed on generalizations by the size of the sample tested and the validity of the measuring device used, the three experimental methods employed are at least as effective as normal classroom procedures in teaching a specific body of factual knowledge.

The accepting of hypothesis one indicates that the independent directed study method is sufficiently effective to warrant its use in certain subject matter areas. Further refinements in study guide construction, application of visual aids, and text and reference selections might result in significant improvements to this method, whereas countless attempts along these lines have already been evaluated with limited success, in the normal classroom.

Hypothesis two is rejected on the grounds that the teacher lecture method is significantly superior to the normal instruction method. While this method embodies the one uncontrollable variable, teacher ability, the findings tend to substantiate the claims of the many devotees of the method. In making generalizations based on these findings it must be borne in mind that:

1. The ability of the teacher is an essentially uncontrollable variable.

2. In this study, the method was lecture only, and both students and teacher were constantly aware of the limitations imposed thereby.

3. The teacher had taught three classes each day, covering the same materials, prior to meeting with this group.

4. Teachers tend to lecture to the lower and middle ability students. The I.Q. scores of the Group II students, as measured by the California

Mental Maturity test, ranging from 93 to 129, with a mean of 108.82. The I.Q. scores of the control group ranged from 60 to 137, with a mean of 98.34. With due consideration to the limitations, it may be concluded that we have to date, found no adequate replacement for a talented lecturer.

Hypothesis three is accepted as stated. The independent directed study method proved as efficient in gaining desired goals as the normal instruction method. While a superficial appraisal of these findings might lead to the belief that the two, therefore, are in all ways equal, a more careful evaluation reveals many significant implications.

Some major implications resulting from the employment of the independent directed study method are noted below.

1. The teacher is freed from many daily routine activities. Properly utilized, the time gained thereby could be of infinite value to teachers and to the total education process.

2. The detailed pre-planning involved may result in a general upgrading of course materials presented and of communication techniques, since:

   a. creation of study guides is simplified if two or more teachers cooperate, thus allowing for the incorporation of the "best" talents of each one.

   b. course or subject matter unit objectives may be outlined and the study guide materials specifically designed to attain the objectives.

c. provisions may be made for obtaining any special materials and equipment well in advance of dates needed.

3. Further improvements of study guides and reference materials may bring about significant increases in student achievement. The guides used in this study, while designed according to criteria established by several earlier studies, represented, nonetheless, the initial attempt on the part of the two participating teachers. During the course of the experiment, both teachers noted areas of weakness in the guides used, and offered suggestions for improvement.

4. No attempt was made to increase the effectiveness of the study guides by introducing audio-visual materials. Attempts at this might well be the focus of further study.

5. The effectiveness of the method could logically be increased if the method were applied only to those portions of the learning process in which it was proved most valuable. Available evidence seems to indicate that it is best applied to portions involving the learning of a body of specific facts, terms, processes, and vocabulary words.

Hypothesis four tests one attempt at segregating teaching methods within the frame work of the typical classroom. The hypothesis is accepted, indicating that the segregation, as designed, neither added nor detracted from the total learning. While it was hoped that this method might result in significant increases in learning, the increases failed to materialize in practice. Further development of techniques of application are in order and could prove a fruitful area for further study. The students taught by this method in this study used the same study guides as the group III students.

Since the study guide was designed to cover all of the unit topics, the teacher experienced some difficulty in preparing appropriate lectures without repeating study guide materials. It should be noted, too, that the unit test was designed to measure achievement only to the limits of the normal instruction group and thus would not measure gains made by students in areas not outlined in the original design.

The findings of this experiment lead to the belief that significant increases in student achievement of factual knowledge may be realized only when the effect of each factor in the teaching process and the interaction among two or more factors working in conjunction is clearly understood. No single method, it seems, will ever prove to be the "best" for all cases. To accomplish this segregation, specific objectives must be determined and the appropriate method must be employed to achieve each objective. Once this was accomplished, the application of the various communications media, designed to increase learning, might well prove more successful.

Of particular interest to this writer is the evident efficacy of the independent directed study method. In view of the many possibilities for improvement noted in the preceding paragraphs, it appears that this method affords the greatest opportunity for enriching the curriculum of any single method tested.

DISCUSSION

The finding that as much as 85% of course learning may result from sources other than the teacher has important implications for media research. Most media have been prepared for teacher use. If instruction is the only means of promoting learning the value of the media can be demonstrated. In most cases where media are compared with normal instructional methods we find the normal method placing heavy reliance upon the textbook. In these instances we would not expect the new media to produce substantial increases in learning.

The role of the teacher as the only source of knowledge about the course was dramatically demonstrated in this study. This method required a great amount of preparation and effort in presentations not normally required in teaching. The new media and books are well suited to provide this type of information.

APPENDIX A

Directions for construction of study guides to be used in the Nuclear Energy Unit

Study guides are to be so designed as to allow for completely independent study on the part of each student. Short, descriptive paragraphs should introduce each phase of the unit. Instructions should refer student to appropriate text readings. Questions related to assigned readings are to be presented in any appropriate manner, such as completion, matching, or multiple choice, within the body of the study guide.

Provision should be made for periodic reviews and quizzes on materials covered. All questions must be accompanied by concise references, directing students to correct responses for the purpose of checking their work independently.

Students are to be instructed by teachers on proper use of study guides. Teachers may assist students who experience difficulty in following the study guide instructions, but may not supply answers for students.

Wherever possible, references to several texts should be listed, giving students a choice and variety of reading materials. Library reading list should be included in the study guide.

Allowance should be made for students who may complete regular readings prior to the conclusion of the unit of study by the inclusion of specific recommendations for library readings and suggestions for independent projects.

Study guides are to be checked by teachers with each student, during class time, and teachers are to call attention to errors or omissions and direct students to appropriate reference materials which contain correct responses.

APPENDIX B

BOOKS IN THE CENTRAL PARK SCHOOL LIBRARY ON NUCLEAR ENERGY USED BY THE INDEPENDENT STUDY GROUP

AUTHOR	TITLE	LEVEL OF DIFFICULTY
Asimor	Inside the Atom	N.A.
Beeler	Experiments with Atomics	N.A.
Bischof	Atoms at Work	Easy
Davis	Atomic Facts	Very Difficult
Dietz	Atomic Energy in the Coming Era	Very Difficult
Eidinoff	Atomics for the Millions	
Freeman	All About the Atom	Very Easy
Haber	Our Friend the Atom	N.A.
Hecht	Explaining the Atom	N.A.
Hyde	Atoms Today and Tomorrow	N.A.
Jukes	Man Made Sun	N.A.
Jung	Brighter than a Thousand Suns	Difficult
Lewellen	You and Atomic Energy	Very Easy
Leyson	Atomic Energy in War and Peace	N.A.
Mann	Peacetime Uses of Atomic Energy	N.A.
May	There's Adventure in Atomic Energy	Very Easy
Pear	The Tenth Wonder: Atomic Energy	N.A.
Potter	Young People's Book of Atomic Energy	N.A.
Ross	Superpower	Difficult
Yates	Atomic Experiments for Boys	N.A.

N.A. - Not Available

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STUDY OF NEW MEDIA SUGGESTIONS FOR IMPROVING TELEVISED SCIENCE INSTRUCTION

Catherine M. Bailey
Hildreth H. McAshan

The study reported herein was supported in part by grant No. 7-30-044.00 from the United States Office of Education, Department of Health, Education and Welfare.

The University of the State of New York
The State Education Department
Bureau of Classroom Communications

June 1964

Table of Contents

Page

FOREWORD 39

Summary Abstract 40

THE PROBLEM 41

RELATED RESEARCH 42
    Communications media 43
    Staff utilization 44

IMPORTANCE OF THE STUDY 46
    Population 48
    Materials used 48
    Design 49
    Testing procedure 51

TEST RESULTS AND ANALYSES OF DATA 52

CONCLUSIONS 55

APPENDIX 58

REFERENCES 59

FOREWORD

This study was a first attempt to demonstrate the transferability of rules or suggestions for improving instruction with new media from research situation to the classroom and to classes taught by television instruction. An effort was made to keep the instruction by the three experimental methods as normal as possible even though television and many new media were being employed. This study was initiated as an essential step in securing implementation of the research throughout the state.

This research would not have been possible without the cooperation of the Troy High School, Troy, New York and the Audio-Visual Director of the Troy Public Schools, Miss Catherine M. Bailey.

Although this study did not demonstrate an increase in learning through use of the new media it did demonstrate the effectiveness of two methods of providing television instruction utilizing a team approach to teaching.

STUDY OF NEW MEDIA SUGGESTIONS FOR IMPROVING TELEVISED SCIENCE INSTRUCTION*

Catherine M. Bailey
Hildreth H. McAshan

Summary Abstract

In a prior study of the use of new media to improve science instruction** certain rules or suggestions were developed. If research demonstrating improvements in instruction are successful the results should be transferable to new situations. The purpose of this study was to study the effectiveness of these rules in improving a three week unit in earth science. It was also desired that their applicability to television be studied. Three experimental methods each employing the suggestions for use of the new media were compared with normal classroom instruction. These methods were (1) improved classroom instruction, (2) closed circuit instruction for 30 minutes plus classwork for 20 minutes and (3) closed circuit television for the entire period. Three hundred forty nine ninth grade general science students were taught for three weeks by four teachers and then were tested. Analysis of data revealed no significant learning increases by the experimental group.

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*This research was supported in part by Grant No. 7-30-044.00 from the United States Office of Education, Department of Health, Education and Welfare. The principal investigator was Loran C. Twyford. The research was organized and directed by Catherine M. Bailey. Hildreth H. McAshan was research coordinator.

**New Media for Improvement of Science Instruction by Loran C. Twyford, John G. Church, Hildreth H. McAshan and Robert M. Brown. New York State Education Department, Albany, New York.

THE PROBLEM

The purposes of this study were (1) to determine to what extent the findings and recommendations for improving instruction in ninth grade general science using audio and visual materials can be transferred to different learners in a conventional classroom presentation (2) to determine which of two patterns of television instruction provided this improved instruction more effectively, and (3) to investigate further instruction involving individual and group activities in two or more television classes simultaneously.

Among the subsidiary questions considered important in this study were: What is the relative worth of recommended procedures and materials when used by different teachers? What supervisory help is needed for locating and providing instructional materials for improvement of instruction in the classroom? How much technical training is necessary to prepare a teacher to use new educational materials and equipment? How much technical training is necessary to prepare a teacher to teach on television? To what extent can a closed-circuit telecast utilize the special talents of individual teachers and permit them to share the work as a team and have more time to prepare individual lessons? Does television do a "total teaching job" in the science class or is it better when used as an aid for a shorter period of time?

Never in history has more technological progress been made that directly affects educational practices. This educational revolution is producing materials, equipment, and other teacher aids which may completely revise classroom techniques of instruction. It now appears that one of our greatest concerns should be the proper evaluation of these technological developments

and their implications for future teacher training. We now know that audio-visual and communications aids including television can improve learning when properly used. Thus, our problem becomes that of discovering the best materials and equipment available and to determine how to use them most effectively.

A study designed to determine the extent to which ninth grade science instruction can be improved through the use of educational communication media was underway before this study was begun. Additional research was needed to discover if the findings and recommendations resulting from that study could be transferred to different learners in new situations. Further investigation was also needed to determine the possibility of combining these findings and recommendations with patterns of television instruction in order to extend the improved lesson to two or more classes at the same time.

RELATED RESEARCH

In 1960, over half a million students from kindergarten through college were receiving regular instruction by television.[1] Early television studies were conducted to determine if students could learn as much by television as from conventional instruction. Schramm suggests that we need to extend the scope of our television studies rather than to continue to research the same questions.[2] In a report of a seminar held at N.E.A. headquarters in May 1957, the experts agreed that there was an overemphasis on direct teaching.[3] Assuming that the question of direct teaching has been answered, procedures need to be developed to secure answers to the many questions still remaining. These might well include problems included in this study such as concomitant learning, the curriculum, teaching methodology, teacher planning and the roles of both the studio and classroom teacher. By the use of television the teachers may find it possible to present a superior lesson and still have more time to carry out other significant responsibilities of teaching.[4]

Communications media

Research in the use of educational communications media has far surpassed in number those concerned with television. Allen states that educational media studies probably number about three thousand.[5] Many studies have shown conclusively that audio-visual materials can convey facts which increase learning.[6] Furthermore, these facts may be presented more efficiently, save instructional time, and be retained longer than by traditional teaching methods. Other studies reveal that these media can influence attitudes, opinions, and even behavior.

The use of the newer educational media has been closely correlated with teaching methods and techniques of classroom presentation. Most study results show greater improvement when the teacher employed such techniques as direct and contrived experiences. These techniques and other communication devices stress thinking rather than memorization, and understanding rather than a mere acquisition of facts. Among the educational media that have been studied are motion picture films, slides, filmstrips, graphic materials, and three dimensional objects. To this list must now be added the overhead projector, one of the most versatile of the newer audio-visual devices.[7] This machine, sometimes compared with the chalkboard, has added new techniques to the teaching of both normal and large groups. Advantages attributed to this new device include equal and better visibility for all students, savings in instructional time, and better teacher-student interactions.

Staff utilization

The teacher shortage is possibly the greatest single problem facing our schools today. One approach to solving this shortage has come to be associated with J. Lloyd Trump.[8] Among the findings included in his studies are new methods of organization, the use of new technical devices, and new concepts of the role of the teacher. One basic way of solving the teacher shortage appears to take the teacher out of the classroom. By combining the talents of several teachers their influence is extended to many more students. This has become known professionally as "team teaching."

In Evanston, Illinois four teachers share their specific skills.[9] In 1957 three teachers at the same grade level worked as a team in an elementary school in Flint, Michigan and planned a program for ninety-nine pupils.[10] In Lexington, Massachusetts both heterogeneous and homogeneous groupings of students were used in every grade.[11] According to the findings of the studies of the National Association of Secondary School Principals,[12] the following conclusions are justified:

1. Students can learn when taught by means of television, tapes, overhead projectors, instructional films, and other media.

2. Size of class in itself has little relationship to the achievement of students.

3. Students can learn materials as well in large groups of over 100, as in traditional groups of 25.

The students generally preferred courses to be taught by a combination of television lecture and discussion rather than television alone.[13] Teachers found that students changing classes at the first grade level caused no undue confusion.[14] Teachers also have found that they can very readily and effectively learn to use electronic and mechanical instructional aids with a minimum of training.[15]

The studies in class size and staff utilization are as encouraging as those concerning educational television and educational communications media. However, the problems of education today are by no means solved by our ability to instruct effectively large numbers of students through the use of television and electronic equipment. Nevertheless, we can safely say that the results of previous studies are favorable and should be considered in the planning of future studies, in training our teachers, and in developing the curriculum.

IMPORTANCE OF THE STUDY

There is no longer any doubt that the effective use of the newer educational media will improve instruction. It now seems imperative that the findings of research be applied to the possibility of bringing about major changes in the educational program and in the instructional practices used in the classroom. Before any drastic changes are recommended, there are many needs to be investigated. Some of these needs are:

1. To be able to identify the sections of the curriculum that can be best presented using audio and visual materials.
2. To establish the relative worth of prepared packets of recommended procedures and materials when used by different teachers.
3. To develop methodological approaches especially tailored for teachers using television and other electronic equipment.
4. To develop activities that better prepare classes for a telecast and capitalize on it afterward.
5. To discover if supervisory help in locating and providing instructional materials improves instruction in the classroom.
6. To determine the amount of technical training necessary to prepare a teacher to use educational materials and equipment.
7. To determine the amount of technical training necessary to prepare a teacher to teach on television.
8. To determine how television can be used to raise questions rather than give answers.

9. To know to what extent different kinds of techniques and programs influence the teacher's use of the newer media in the classroom.

10. To determine to what extent a closed-circuit telecast can utilize the special talents of the individual teachers.

11. To determine to what extent closed-circuit television connecting several classes permits teachers to share the work and allows them more time to prepare lessons.

12. To know if television can do a "total teaching job" or if the telecast does a better job when used as an aid.

13. To develop procedures that make it possible to test the full spectrum of learning in ordinary classes.

There is no one method of teaching that is best. In planning any lesson considerations must be given to the information to be taught, the physical limitations such as time and space, and last but not least the learners. The majority of teachers use a combination of methods and techniques during a single class period. Through personal contact of working with a class, the teacher counts on the questions of the students and various visual cues to tell him or her how the lesson is progressing. The timing within a class period permits a change of method and even permits review or reteaching. Perhaps, we are expecting too much when we depend upon one piece of educational equipment to do a total job. There is ample evidence regarding the effectiveness of television and other audio-visual aids when tested in isolation. It is now imperative that these findings be put to work to discover to what extent the newer media, either when used alone or in combination, can be used to carry on the individual and group activities of the classroom. Different patterns of instruction using a variety of audio and visual equipment including television were tested in this study to determine if interaction can be brought about through mechanical devices. Although the study was concerned with ninth grade science instruction, the findings are applicable to other areas of the curriculum.

Population. The subjects for this study were 422 ninth grade science students at Troy High School, Troy, New York. The selection and division of these subjects into groups was by random assignment of students assumed to be of average ability. One control and three experimental groups were used as the basis for making comparisons. Teachers were randomly assigned to classes for the teaching of the experimental and control units. Variables controlled by the study included heterogeneity of sex and ability of the students, comparable classes having instruction by the same teacher, length of instructional period and evaluation by the same instrument.

Materials used. Since this experiment involved diversified patterns of instruction, a large number of materials and technical equipment were used. Among these materials and equipment were the following:

1. Audio-visual materials such as charts, still pictures, objects, specimens, models, transparencies, filmstrips, slides, movie films, printed pamphlets, and maps.
2. Lesson content was developed from recommendations and materials resulting from a general science study conducted at the Philip Livingston Junior High School, Albany, New York.

3. Equipment included the opaque projector, 3 overhead projectors, a filmstrip projector, a 16mm sound motion picture projector, and a small closed circuit television system including a single camera with seven monitors.

4. Special activity and study guides were developed to prepare the students for viewing the telecast.

Design. The researchers chose a matched group technique as the best method of determining what changes among the sample population could be attributed to the effects of the experimental controls. In both planning and carrying out of the experimental situations, consideration was given to the obtaining of results which would be of practical value in future teaching situations.

Five teachers participated in the study. The matching of groups was so arranged that all comparisons between control and experimental groups or between any two experimental groups had the same teacher in both instructional patterns. This same pattern was also true for comparisons made between combined groups. In the final analysis of the results, the hypotheses were accepted or rejected upon the basis of mean comparisons between groups formed by combining as many like classes as possible under the design of the study.

Tests were developed to evaluate student achievement in the experimental unit on earth science. All tests were administered to the students in a manner that did not require the students to take the test more than one time. This prevented any interaction between a pre-test and the experimental data. The test included major informational data which was available to the students through each of the instructional patterns employed by the teachers. The experimental design may be viewed graphically by reference to Figure 1.

EXPERIMENTAL DESIGN

I Control Group (130 students)	II Experimental Group (129 students)	III Experimental Group (134 students)	Experimental Group (29 students)
1. Classroom instruction by three teachers using conventional methods. Three weeks duration.	1. Classroom instruction by four teachers using newly recommended procedures and materials. Three weeks duration.	1. Televised instruction by four teachers of the lessons improved by the recommended procedures and materials utilizing 30 minute telecasts supplemented by classroom activities. Three weeks duration.	1. Televised instruction of the lessons improved by the recommended procedures and materials using a full class period for the telecast. Three weeks duration.
2. Test immediately following completion of the unit.	2. Test immediately following completion of the unit.	2. Test immediately following completion of the unit.	2. Test immediately following completion of the unit.
3. Analysis of data.	3. Analysis of data.	3. Analysis of data.	3. Analysis of data.

Figure 1.

The list of rules or suggestions (appendix) developed during the science study was used to improve instruction of the three experimental groups. The five teachers participating in the study were given these rules and asked to utilize them in their teaching. Materials were provided them which conformed to these suggestions. No special training was given the teachers on use of the suggestions since this would have made the utilization situation atypical, and the research results would not have been generally applicable.

Testing procedure. Information was collected on each student's past and present achievement in science and other subject matter areas. An I.Q. score was known for each student. A 67 item achievement test was administered at the end of the unit. The validity of the test was established by bi-serial correlations and items which had a validity index of .25 or less were not used. This reduced the test to 55 items with a possible raw score of 55. The estimated reliability of the test was .84 as determined by the method of rational equivalence. The test had a high ceiling but it did not cover all the material studied by the experimental groups which covered nearly twice as much material as the control groups. The experimental groups proceeded through their studies at a faster pace than the control, but they were not tested on this additional information.

TEST RESULTS AND ANALYSES OF DATA

Complete data was obtained from 422 students.

I. RESULTS OF THE TEST.

Since all groups used the same test, the individual scores made by the students were used in the statistical analysis. An analysis of variance of test scores combining all pupils taught by the same method was made. In addition, analysis of covariance was computed in which the variation of test scores was corrected for differences in I.Q. and class average. The results of these analyses indicated no significant differences among the method. It did not appear from the data, therefore, that any one of the methods was preferred to the others.

Details of the analysis of variance appear in Table 1.

TABLE 1

ANALYSIS OF VARIANCE OF TEST SCORES

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Methods	745	3	248.3	.93
Error	111,790	418	267.4	

Since F. is less than one, it is clearly not significant.

The details of the analysis of covariance are given in Table 2.

TABLE 2

ANALYSIS OF COVARIANCE OF TEST SCORES WITH CORRECTION FOR IQ AND CLASS AVERAGE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Methods	239	3	79.67	1.10
Error	36,014	416	72.15	

Although F. is somewhat greater than one, it is so low as to be regarded as not significant.

An additional covariance analysis controlling IQ only gives a somewhat higher value for F, but even this value falls short of the .05 level of significance.

Table 3

ANALYSIS OF COVARIANCE OF TEST SCORES WITH CORRECTION FOR IQ

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Methods	905	3	301.67	2.13
Error	58,920	417	141.30	

The purpose of the study was to determine if the recommendations and findings for improved science instruction found effective in one situation could be transferred and used by other teachers in New York State. As represented by the sample population tested, the second phase of the experiment was to investigate procedures that would extend the value of an improved lesson to larger groups of students. Emphasis was placed on the utilization of the special abilities and interests of the teaching staff by cooperative planning and by using closed-circuit television to extend the improved instruction to several classes simultaneously.

The children in the three experimental groups received somewhat greater mean scores than the children receiving traditional instruction. The difference, however, was so low as to be regarded as not significant. Ninth grade science students, who were taught by the improved method of instruction in the classroom, or by means of a televised lesson either for part of the period or for the entire period, learned the same as students who were taught by the traditional method.

CONCLUSIONS

The two purposes of the study were to (1) determine to what extent the findings and recommendations for improved instruction of a ninth grade science class using audio and visual materials could be transferred to different learners and (2) to further investigate methods of extending instruction to larger than average classes.

The three experimental groups scored higher than the control group, but the differences were not statistically significant. The six hypotheses tested are restated:

1. Ninth grade science students, who were taught by the improved method of instruction, learned the same as students who were taught by the traditional method.
2. Ninth grade science students in larger than average classes, who were taught by a team of teachers using a thirty-minute telecast supplemented by classroom activities that provided interaction between teacher and class learned the same as students who were taught by the traditional method.
3. Ninth grade science students who received the improved lesson on television for the entire period, learned the same as students who were taught by the traditional method.
4. Ninth grade science students, who were taught by a team of teachers using a thirty-minute telecast supplemented by classroom activities that provide interaction between teacher and class, learned the same as students who were taught by the improved method.

5. Ninth grade science students, who received the improved lessons on television for the entire class period, learned the same as students who were taught by the improved method of instruction in a regular classroom.

6. Ninth grade science students, who were taught by the improved method of instruction on television for the entire class period, learned the same as students who were taught by a team of teachers using a thirty-minute telecast supplemented by classroom activities that provided interaction between teacher and class.

Although the differences between methods were not significant, there are some implications to be drawn from the experiment. The study indicates the effectiveness of cooperative planning and the use of audio-visual materials and equipment to improve learning. The students had a better understanding of many phases of the unit after viewing films, filmstrips, and slides. Interest increased, and discipline problems seemed to decrease in the larger classes. The teachers felt that they were better prepared when they had extra time and were given help in locating and in producing materials for instruction. As more experience was gained in using equipment and in preparing the lessons, it was felt that a greater improvement both in the quantity and quality of the instruction was possible. Many of the opinions and criticisms expressed by the teachers at the start of the experiment were favorably changed as operational techniques were developed and improved.

Future investigations might be made concerning the following:

1. A study of all possible ways of arranging school programs to permit teachers to work together and share in the preparation of lessons.

2. A study of means by which opportunities can be given to teachers to participate in all stages of learning projects to secure the proper attitudes and climate necessary for research.

3. A study of the possibility of improving television lessons by producing materials and developing techniques that can be used effectively with a single camera closed-circuit television system.

4. A study of the effect of in-service training for the teachers both in using equipment and in the production of visuals, tapes and slides.

5. A study of the results of the same experiment, repeated a second time using the same teachers. (Does experience with the method increase learning?)

APPENDIX

List of Rules and Suggestions

1. Instructional films can be used effectively to introduce a unit of work, to present facts, and to review units of work.
2. Didactic films have resulted in a high degree of learning.
3. Learning is increased when guide questions displayed near the screen are used during the presentation of films, filmstrips, and other instructional materials.
4. Learning is hindered by stopping a film to study a single frame.
5. Students learned more when viewing films in which they are looking for answers to questions than when viewing without questions given prior to the film.
6. The overhead projector is an effective teaching device and saves valuable teaching time when used to present test questions, to assign homework, and to correct assignments.
7. Overhead transparencies or 10" x 10" slides in simplified form, when used to explain or extend textbook information, are effective.
8. The practice of recording the script of a filmstrip before class is effective and saves valuable class time.
9. Learning is increased by the showing of the same film two or three times.
10. Vocabulary words are of greater value to understanding when accompanied by an illustration.

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STUDY OF THE TRANSFERABILITY OF SUGGESTIONS FOR IMPROVEMENT OF SCIENCE INSTRUCTION

Sharon W. Miller
Robert M. Brown

The study reported herein was supported in part by grant No. 7-30-044.00 from the United States Office of Education, Department of Health, Education and Welfare.

The University of the State of New York
The State Education Department
Bureau of Classroom Communications

June 1964

Table of Contents

Page

FOREWORD 63

Summary Abstract 65

Purpose of Study 65

METHOD 66
- Experimental design 66
- Subjects 66
- Experimental treatment 66
- Evaluation procedures 68

RESULTS 70

DISCUSSION 73

APPENDIX I - Suggestions for Improving General Science Utilizing the New Educational Media. 74

APPENDIX II - Extra Educational Communications Materials 76

APPENDIX III - Teacher Interviews 79

APPENDIX IV - Student Interviews 85

FOREWORD

This study was one in a series designed to improve the instruction of ninth grade science through the introduction of a variety of new educational media. In a year long study new media were introduced into a course of instruction with a 4.8% increase in learning. Because of the experimental nature of the study and the limited number of students involved it was thought to be desirable to replicate the study under better conditions. This report describes the results of that study.

This study was conducted at the Chatham Central High School and at the Guilderland Central Junior High School. Appreciation is extended for their assistance.

This study is probably of greatest interest to research workers and those who analyze this entire series of reports.

This particular study was designed as a follow-up study to the year of research completed at Philip Livingston Junior High School in Albany. During the year, day to day analyses of learning in ninth grade science classes were made using a learning profile technique. A number of suggestions for the improvement of learning were compiled during the course of the study based upon study of learning by classes using visual materials. In this study these principles were employed to assist teachers to improve instruction through use of the new media. It also was important to discover whether teachers could use these guides to improve new media utilization and produce an increase in learning in their students. The suggestions which the teachers employed are presented in the Appendix I.

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STUDY OF THE TRANSFERABILITY OF SUGGESTIONS* FOR IMPROVEMENT OF SCIENCE INSTRUCTION

Sharon W. Miller
Robert M. Brown

Summary Abstract

Seven classes in general science were taught a unit on machines and another on matter and energy using the new media. The teachers involved selected the instructional materials they felt were useful and followed a set of suggestions concerned with methods for improving instruction with the new media. A science survey test was utilized to compare abilities of the students in the two schools. A pretest was given each group prior to instruction on that topic. Students and teachers were interviewed after the unit to discover their attitudes toward the science course, school in general and the various educational media. The students were interviewed a second time to discover just where they felt most learning took place. Teachers were interviewed to discover their opinions about the suggestions for improving science instruction. Learning by the experimental groups was slightly greater than for the control groups but the difference was not significant. Teacher interviews revealed general approval of the suggestions for improving instruction. Students felt the new media were helpful in the learning situation. Interviews concerning the source of student learning were not conclusive.

Purpose of study

The purpose of this study was to determine the extent to which the introduction of new educational media into two units of general science would improve instruction. It was a further purpose to obtain teacher reactions to a set of suggestions for use of the new media that had been developed in an earlier study.**

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*This research was supported in part by Grant No. 7-30-044.00 from the United States Office of Education, Department of Health, Education and Welfare. The principal investigator was Loran C. Twyford. The study was conducted by Sharon W. Miller under the direction of the research coordinator Robert M. Brown.

**New Media for Improvement of Science Instruction. Loran C. Twyford, John G. Church, Hildreth McAshan and Robert M. Brown, New York State Education Department, Albany, New York.

METHOD

Experimental design

Seven general science classes in two schools were taught two units; one on machines and a second on matter and energy. Half of the classes were experimental and half were control during the first two week period. The control classes became experimental during the second two week period. The units were taught at the normal time in the general science sequence and except for the introduction of the new media the instructional situation was maintained relatively normal. Table I indicates the general design of the experiment.

Subjects

The students that participated in the study were enrolled in seven classes of ninth grade general science at the Chatham Central High School and the Guilderland Central Junior High School. When plans were made for the project the previous year the school administrators agreed to place students of "average ability" in these classes and to make the experimental and control classes comparable.

Experimental treatment

The teachers of the experimental groups were asked to use as many audio-visual materials as possible. These materials were on hand and had been used in the previous study at Philip Livingston Junior High School where they had been evaluated. The materials were largely filmstrips and 10" x 10" transparencies for the overhead projector. The teachers selected those that they felt would be appropriate for their classes. They were also encouraged to order other teaching materials such as films, filmstrips, and made-to-order transparencies. When the teacher did not take advantage of as many materials

School	Chatham		Guilderland	
	Period	**Treatment**	**Period**	**Treatment**
Unit	"Machines"		"Matter and Energy"	
First two weeks	2	Control	1	Experimental
	3	Experimental	2	Control
	4	Control	3	Experimental
	6	Experimental		
Unit	"Matter and Energy"		"Machines"	
Second two weeks	2	Experimental	1	Control
	3	Control	2	Experimental
	4	Experimental	3	Control
	6	Control		

Table I Treatment of classes being taught two units of general science

as seemed desirable the communications specialist of the project ordered films and prepared transparencies and offered them to the teacher. The extra materials which the teacher was urged to use are listed in Appendix II.

An overhead projector was left in each school for the duration of the project. With the exception of a motion picture screen for the Guilderland School no other equipment was provided for the teachers. It was assumed that they would have access to the projectors in their schools.

The teachers were instructed in the set of rules or suggestions which had been developed for improvement of science instruction. While teaching the unit the teacher would try to follow these suggestions.

In the control classes the teachers followed the normal routine which consisted of lectures, chalk-talks, discussion and assignments from the text. If they used communications media they continued to do so but they were asked specifically not to use new materials in the control classes.

Evaluation procedures

Two tests which had been developed in the earlier science study were used to measure learning. The test on machines consisted of 50 multiple choice items while the test on matter and energy consisted of 70 multiple choice items. Each contained visual items in addition to verbal items. The test had an approximate reliability of .92 as determined by the rational equivalence method. No question had a validity index of less than .25 as determined by a bi-serial correlation. The tests were designed to cover the units completely, but not to test learning from a specific source such as a particular lesson plan, textbooks or visual material.

Seventy three students in the control group studying the unit on machines were compared with seventy three in the experimental group. There were 82 in each of the groups which studied matter and energy. Tests were administered after each unit.

After the study was completed the two teachers participating in the study were interviewed to discover how well they could apply the suggestions that had been given for improving lessons in their classes. They were asked their opinions of each of the principles and various other questions concerning the study.

Two types of questions were asked the students participating in the study. The first concerned their attitudes toward science, school in general and toward the various educational media. Two students were chosen from each class and their answers to twelve questions were recorded on tape. The second type of question was concerned with the source of their learning. Operating on the premise that much of their learning did not take place in the classroom, an attempt was made to find out if they received much information from other sources. The students were encouraged to talk freely about their learning experiences.

RESULTS

The data were analyzed by calculating pre-test and post-test means for experimental and control groups in each of the science units. Post-test means of experimental and control groups were compared by an analysis of variance. An additional comparison of these means was carried out by analysis of covariance to adjust for group differences in pre-test scores. The analyses are shown in Tables II and III.

An examination of pre-test means in both units shows that they were nearly the same for experimental and control groups, indicating that these groups were nearly equal in achievement at the beginning of instruction. In the machines unit the post-test means for the experimental group was higher than for the control group, but the relationship was reversed for the matter and energy unit.

The comparison of post-test means by analysis of variance, appearing in Table III, indicates that the differences between the means are not statistically significant. The same conclusion can be drawn from the analysis of covariance which compares the post-test means after adjusting them for differences in pre-test scores.

The analysis does not, therefore, indicate superiority of either method of instruction over the other for improving pupil achievement.

An item by item record of teacher interviews is included in Appendix III. In general the teachers felt that most of the suggestions were basically good, but that a classroom teacher with a full schedule might have a difficult time following all of them. For example, both teachers felt that they didn't have time to use a film more than once as was suggested. They also mentioned

TABLE II PRETEST AND POST-TEST MEANS OF CONTROL AND EXPERIMENTAL GROUPS

Science Unit		Control Groups	Experimental Groups
Machines	N	88	53
	Pretest Means	17.5	16.7
	Post-test Means	25.4	26.1
Matter and Energy	N	79	81
	Pretest Means	33.9	33.8
	Post-test Means	42.2	41.6

TABLE III COMPARISON OF EXPERIMENTAL GROUP WITH CONTROL GROUPS ON POST-TEST MEANS BY ANALYSIS OF VARIANCE AND ANALYSIS OF COVARIANCE

Science Unit	Analysis of Variance	Analysis of Covariance
Machines	F = .40 d.f. = 1;139	F = 1.42 d.f. = 1;137
Matter and Energy	F = .22 d.f. = 1;158	F = .04 d.f. = 1;156

equipment limitations as a problem. For example, they would not be able to project a set of questions at the same time as a film. Both teachers thought that materials could be used if they were available. They thought that a teacher might not know his lesson plans far enough in advance to have specific visuals made up in time for use in class. One teacher said he normally used so many visual materials that he would probably not be adding many to enrich his instruction.

In general, students felt that educational media were helpful in the learning situations. They responded with varying degrees of enthusiasm toward science. A question-by-question analysis of student responses appears in the Appendix IV.

The interviews with students concerning the sources of their learning did not reveal very specific information. For the most part they all stressed that learning takes place in the classroom in the form of facts taught by the teacher. The answers may have reflected loyalty to their teachers.

DISCUSSION

The improvement in learning through use of the new media was no more than had been discovered in the initial experiment which was reported earlier. Clearly, if increases of twenty percent or more are desired entirely new methods must be employed to bring this about.

The teachers were generally able to follow the suggestions given for improvement of science instruction. This study was not designed to determine the specific contribution made by the suggestions. Perhaps visual materials are already contributing strongly to the effectiveness of science teaching.

This study gave some insight into reasons why greater increases in learning from a unit of instruction are not brought about through the introduction of media. A later study followed up these leads.

APPENDIX I

I. Suggestions for Improving General Science Utilizing the New Educational Media.

- I. General teaching procedures:
  - A. Go quickly to the point. Learning is low during introductions whether in films or in lectures.
  - B. Present new information, or present repeated information in a new way. Do not rehash what a student has already read in a textbook.
  - C. Bring some new media very early into the class presentation. Classes beginning with lecture or discussion resulted in very low learning.
  - D. Use a variety of educational media. Do not begin to use one type of media day after day.
  - E. Plan to cover more material.
- II. Motion Pictures:
  - A. See if a motion picture is available to cover each topic. Preference should be given to films since they are most effective.
  - B. Ask the students to look for answers to specific questions as they view the films.
  - C. Use the films more than once.
  - D. Skip general introductory, dramatic, and historical sequences in films.
- III. Overhead projection:
  - A. Plan the design and content of the transparencies yourself.

B. Present difficult points by simple, clear-cut steps.

C. Save time by using the overhead for routine tasks.

D. Use the overhead for frequent quizzes which are to be considered in class grades.

E. Use the overhead projector as a group tutor device.

IV. Filmstrips:

A. Select pertinent parts of filmstrips.

B. Use the filmstrip as a part of a group tutor device.

C. Make the filmstrips a part of the class.

V. Recordings:

A. Use disc recordings when appropriate and available.

B. Tape record some presentations.

APPENDIX II

Extra Educational Communications Materials

Many visual materials were normally used by the teachers in teaching the units. The materials listed below are the materials used in addition to those normally used.

CHATHAM:

"Machines"

Films:

Simple Machines: Levers	Coronet	5½ min.
Simple Machines: Pulleys	"	"
Simple Machines: Inclined Planes	"	"

Filmstrips:

Simple Machines	Row Peterson

Overhead projector:

- Prepared 10 x 10 slides:
  - Resistances to doing work (3)*
  - Three classes of levers
- Teacher drawing on acetate roll:
  - Class notes (#)
  - Quizzes (2)
  - Homework assignments (#)
  - Diagram - sliding friction, rolling friction
  - Formula and work problems
  - Review of W = F x D ... trick problems
  - Presentation of E x ED = R x RD
  - Idea of MA ...moving lever diagram
  - Description of a wedge
  - Drawing of a jack screw
  - Review for ten week exam

"Matter and Energy"

Films:

States of Matter	McGraw-Hill
The Nature of Energy	Coronet

*The number in parentheses indicates the number of times a particular visual was used. (#) indicates many times.

Filmstrips:

Atoms and Molecules Row Peterson
Atomic Concept, History of Visual Sciences
The Structure of Matter Jam Handy
Matter Jam Handy

Overhead projection:

Prepared 10 x 10 slides:
#21 Two kinds of Energy
22 Five Forms of Energy
3 General Properties of Matter
5 Special Properties
4 General Properties of Matter
2 " " "
1 " " "

Teacher drawing on acetate roll:
Law of Conservation of Energy
Kinetic Molecular Theory
Chart of Atomic Particles
Two Kinds of Energy
Seven Forms of Energy

GUILDERLAND:

"Machines"

Films:

Simple Machines: Levers Coronet
Simple Machines: Pulleys "
Simple Machines: Inclined Planes Coronet

Filmstrips:

Simple Machines Row Peterson

Overhead Projection:

To illustrate problems and machines.

"Matter and Energy"

Films:

None

Filmstrips:

Energy Unlimited	Harbrace
Structure of Matter	Jam Handy
Atoms as You Use Them	Harbrace
Uranium Fission	United World Films, Inc.
The Atom Smashers	"

Overhead projection:

Prepared 10 x 10 slides:
- #1 Matter Occupies Space
- 2 Can't Occupy the Same Space at the Same Time
- 3 Has Weight
- 4 Cannot Easily be Destroyed
- 5 Special Properties
- 6 Definitions
- 7 Periodic Table
- 8 Explanation of Periodic Table
- 9 Inside the Atom
- 10 Force = Mass x Acceleration
- 11 Calcium Chloride Molecule
- 12 Nuclear Reactor
- 13 Isotopes of Hydrogen
- 14 Periodic Table
- 15 Molecules
- 16 Radiation
- 17 Atomic Fission
- 18 Chain Reaction
- 19 Atomic Fusion
- 20 Atomic Reactor
- 21 Kinetic and Potential Energy
- 22 Forms of Energy

APPENDIX III

Teacher Interviews

The two teachers involved in this study were asked their opinions on each of the suggestions for improving science teaching. These interviews were recorded on tape, and a brief summary of them follows. Teacher "A" was from Chatham; teacher "B" was from Guilderland.

I. GENERAL TEACHING PROCEDURES:

A. Go quickly to the point. Learning is low during introductions whether in films or in lectures. "How did you avoid this in experimental classes?"

Teacher A didn't try to avoid introductions as he felt they were necessary for motivation.

Teacher B showed a film first if he was using one that period. He didn't try to use motivation.

B. Present new information or present repeated information in a new way. Do not rehash what the students have already read in the text. "How did this work out in the experimental classes?"

Teacher A used different media to repeat ideas.

Teacher B felt there was not enough time to try out some things such as new ways of presenting films.

C. Bring some new media very early into the class presentation. Classes beginning with lecture resulted in relatively low learning. "How was this handled in the experimental situation?"

Teacher A thought that this was not always convenient since some things needed an introduction.

Teacher B felt that this was handled by using the films, filmstrips, etc. first.

D. Use a variety of educational media. Do not begin to use one type of media day after day. "How did you handle this?"

> Both teachers felt that a sufficient variety was supplied by the department.

E. Plan to cover more material. "Did you?"

> Teacher A felt that with some classes it was possible to go a little deeper into a subject.
>
> Teacher B said that he was pressed for time due to the need for drill in math in these two units. He didn't think that he could cover any more material.

II. MOTION PICTURES:

A. See if a motion picture is available for each topic. Preference should be given to films since they are more effective. "How do you feel about this principle?"

> Teacher A questioned the effectiveness of films. He felt that they were good entertainment, but that many students don't learn from a film.
>
> Teacher B felt that films were good for authority and that the students enjoyed watching them.

B. Ask students to look for answers to particular questions as they view a film. "Did you find the overhead projector to be useful for this purpose?"

> Teacher A didn't apply this idea. He asked questions afterward, and asked students to watch for certain ideas.
>
> Teacher B said that he couldn't use both projectors at the same time due to room limitations.

C. Use the film more than once. "How do you feel about this?"

> Both teachers felt that they didn't have time to show a film more than once.

D. Skip general, introductory, and historical sequences in films.

"Did you feel that this was worthwhile?"

Teacher A thought that this was impossible.

Teacher B thought that it was a good idea since the historical aspects of science are not too important.

III. OVERHEAD PROJECTION:

A. Plan the design and content of transparencies yourself. "How did this work out?"

Both teachers used the acetate roll to present their ideas.

B. Present difficult points by simple, clear-cut steps. "What did you think of the overlay slides?"

Both teachers agreed that some of the slides were good, and were very helpful.

C. Save time by using the overhead for routine tasks. "How did this work out for things like homework assignments?"

Teacher A did not use the overhead projector for this because he could only use it in his experimental classes. Often his homework assignments consisted of several questions which he wrote on the chalkboard. Since he didn't want to write them twice, he put them on the board and left them for all classes to see.

Teacher B stated that "the idea never occurred" to him.

D. Give frequent quizzes which are to be included in class grades. "Did you find the overhead to be useful for quizzes?"

Both teachers felt that the overhead was useful for giving quizzes, but teacher A questioned the idea of frequent quizzes because of the time that it took him to correct them.

E. Use the overhead projector as a group tutor device. "Did you find this useful as a teaching machine?"

Neither teacher seemed to understand this concept although it had been explained at the beginning of the study.

IV. FILMSTRIPS:

A. Select pertinent parts of filmstrips. "Did you find yourself cutting parts of the filmstrips?"

Both teachers cut parts of filmstrips in order to present only certain parts, ot to omit parts that were too difficult or not pertinent.

B. Use the filmstrip as a part of the group tutor device. "Did this in combination with the questions on the overhead seem to work well?"

Neither teacher used this method.

C. Make the filmstrip a part of the class. "How was this accomplished?"

Both teachers presented the filmstrip along with lectures on the same subject.

V. RECORDINGS:

A. Use disc recordings when appropriate and available. "What is your opinion of this principle?"

Teacher A thought they might be useful for some courses.

B. Tape record some presentations. "How successful was this?"

Teacher A didn't record any presentations. He felt that such a presentation would have to be very interesting to hold the students' attention.

Teacher B had used the tape recorder to do a comic presentation of Enrico Fermi, complete with dialect. He felt that the tape recorder had some useful aspects.

A few other questions were asked of the teachers besides those concerning the principles to improve learning:

1. Do you feel that class preparation takes longer when planning to use many visual aids?

    Teacher A said that due to the need for keeping them separate the experimental and control methods preparation might take longer.

    Teacher B said that preparation took no longer.

2. Do you think you could utilize the suggestions for improving science instruction without outside help?

    One teacher thought this could be done in a modified form.

3. In general, was student interest as good or better in the classes that were saturated with visual aids?

    Both teachers agreed that student interest was better.

    Teacher A mentioned that it varied with the group.

4. Do you feel that students learn as much from the visual materials as from, for example, a lecture?

    Teacher A said this was not true in every case.

    Teacher B thought they did, especially from films.

5. Do you feel that with the proper visuals you could cover more work or the same work in a shorter time?

    Teacher A thought this would be possible.

    Teacher B thought this would depend on what subject material was being used.

6. Which of the communications media did you use the most? Why?

Teacher A used the overhead projector most because it was most convenient, it provided variety, and was good for class control.

Teacher B used films (because they fit in well), filmstrips, and transparencies in that order.

7. Which of the communications media do you feel is most useful? Why?

Teacher A thought the overhead and films were most useful.

Teacher B thought that films were most useful because they carried the most authority.

8. What is your opinion of this particular research study?

Teacher A offered to write a paper on all the questions he had about this study.

Teacher B questioned the difference in materials used between the control and experimental classes. In his usual way of teaching, many films, filmstrips, and demonstrations were used. The only real difference between the two methods used in this case was the use of the overhead projector in the experimental classes.

9. Do you think the classes were evenly matched?

Neither of the teachers thought that their classes were evenly matched as to ability.

APPENDIX IV

Student Interviews

1. Which of your subjects is most interesting to you?

CHATHAM	GUILDERLAND
Latin (2)	Science (3)
Science (2)	Social Studies (2)*
Social Studies (2)*	English (1)
English (1)	
Math (1)	

2. In which class do you think you learn the most?

CHATHAM	GUILDERLAND
Algebra (2)	Social Studies (3)
Latin (2)	Science (2)
Science (2)	Math (1)
English (1)	
Math (1)	

3. Which subject is hardest for you?

Social studies (4)	Math (2)
Latin (2)	Science (2)
Algebra (1)	French (1)
Science (1)	Social Studies (1)

Easiest?

English (2)	English (3)
Math (2)	Algebra (1)
Algebra (1)	Science (1)
Latin (1)	Social Studies (1)
Science (1)	

4. Do you think you can learn very much from a film?

yes (6)	yes (3)
"quite a lot" (1)	"Yes, if up to date" (1)
"in a way" (1)	some (2)

5. About how much time do you spend on homework every night?

4 hrs. (1)	3-4 hrs. (1)
2-3 hrs. (1)	2-3 hrs. (1)
1-1½ hrs. (1)	2 hrs. (2)
1 hr. (2)	1 hr. (2)
½ hr. (1)	

*In both schools, social studies and citizenship education seemed to be used interchangably. It is assumed that these titles refer to the same ninth grade subject.

6. Does homework ever interfere with other activities?

CHATHAM	GUILDERLAND
yes (3)	yes (4)
no (3)	no (1)
sometimes (2)	sometimes (1)

7. Do you think you learn very much from a filmstrip?

yes (7)	yes (4)
sometimes (1)	sometimes (2)

8. What subjects do you think will be most useful to you after graduation?*

Math (3)	English (3)
Science (3)	Science (3)
Algebra (1)	Math (2)
Latin (1)	Business (1)
English (1)	Music (1)
Social Studies (1)	Social Studies (1)
Typing (1)	

9. Do you think that an overhead projector makes learning easier?

yes (5)	yes (3)
"in some ways" (1)	sometimes (1)
"it helps" (1)	no (1)
"same as a book" (1)	"filmstrips are better" (1)

10. Which subject do you think will be least useful to you after graduation?

Social Studies (4)	Science (2)
Gym (1)	Social Studies (2)
Latin (1)	English (1)
Intro. to Business (1)	French (1)
	Gym (1)

11. Did the units "Machines" and "Matter & Energy" seem harder, easier, or more interesting than any other units in science?

No (3)	harder (4)
easier (2)	easier (1)
more interesting (2)	duller (1)
harder (1)	"not interesting" (1)

12. Did you know that you were taking part in a research study?

no (7)	yes (5)
yes (1)	no (1)

DEVELOPMENT OF A METHOD FOR MEASURING SOURCES OF LEARNING

Sharon W. Miller
Robert M. Brown

The study reported herein was supported in part by grant No. 7-30-044.00 from the United States Office of Education, Department of Health, Education and Welfare.

The University of the State of New York
The State Education Department
Bureau of Classroom Communications

June 1964

TABLE OF CONTENTS

Page
FOREWORD 89
Summary Abstract 91
Purpose of Study 91
METHOD 93
    Experimental Design 93
    Analysis of data 95
DISCUSSION 99

FOREWORD

This study is another in a series designed to discover why learning from a series of lessons using the new media is so much less than the learning resulting from the use of a single medium such as a film. This study reports on a novel method for measuring sources of learning.

Appreciation is extended to the Chatham Central Schools for their participation and to Rudolph G. Fecketter who taught the lessons analyzed in the study.

This study will be of primary interest to research personnel concerned with the improvement of instruction. The novel approach to determining sources of learning should have greater applicability as educational technology is introduced into our schools.

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DEVELOPMENT OF A METHOD FOR MEASURING SOURCES OF LEARNING

Sharon W. Miller
Robert M. Brown

Summary Abstract

It is important to know whether learning results more from out of class activities than from in-class activities because the contribution of the new media is largely limited to in-class activities. If a major portion of learning occurs from textbook study this could explain the anomaly of little increases in learning resulting from highly effective media. In this study test items were directly based upon what was taught and tests were administered immediately before and after the periods in which learning might occur. The matched groups were employed to eliminate test-retest contamination. Based on this study most of the learning was derived from the teacher's presentation. Extensive forgetting of information was found to occur during the first day.

Purpose of study

The purpose of this study was to develop a method for determining where learning actually takes place and to utilize the method to obtain some information on sources of learning. These sources could be from class work or homework assignments.

It is possible that much of a student's learning comes from some source other than information presented in class. If this were true no matter how much learning could be increased by the utilization of new media it would not significantly increase learning due to the small amount of learning that actually would be taking place where the media were used.

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*This research was supported in part by Grant No. 7-30-044.00 from the United States Office of Education, Department of Health, Education and Welfare. The principal investigator was Loran C. Twyford. Research coordinator was Robert M. Brown. Sharon W. Miller was responsible for carrying out the study.

Several problems were associated with solving a problem such as this. New media often contain much more information than the conventional class presentation. Therefore a special effort was made to have the test reflect the exact content taught. The second problem was that of localizing the exact period during which learning had occurred. A special testing procedure was developed to meet this requirement.

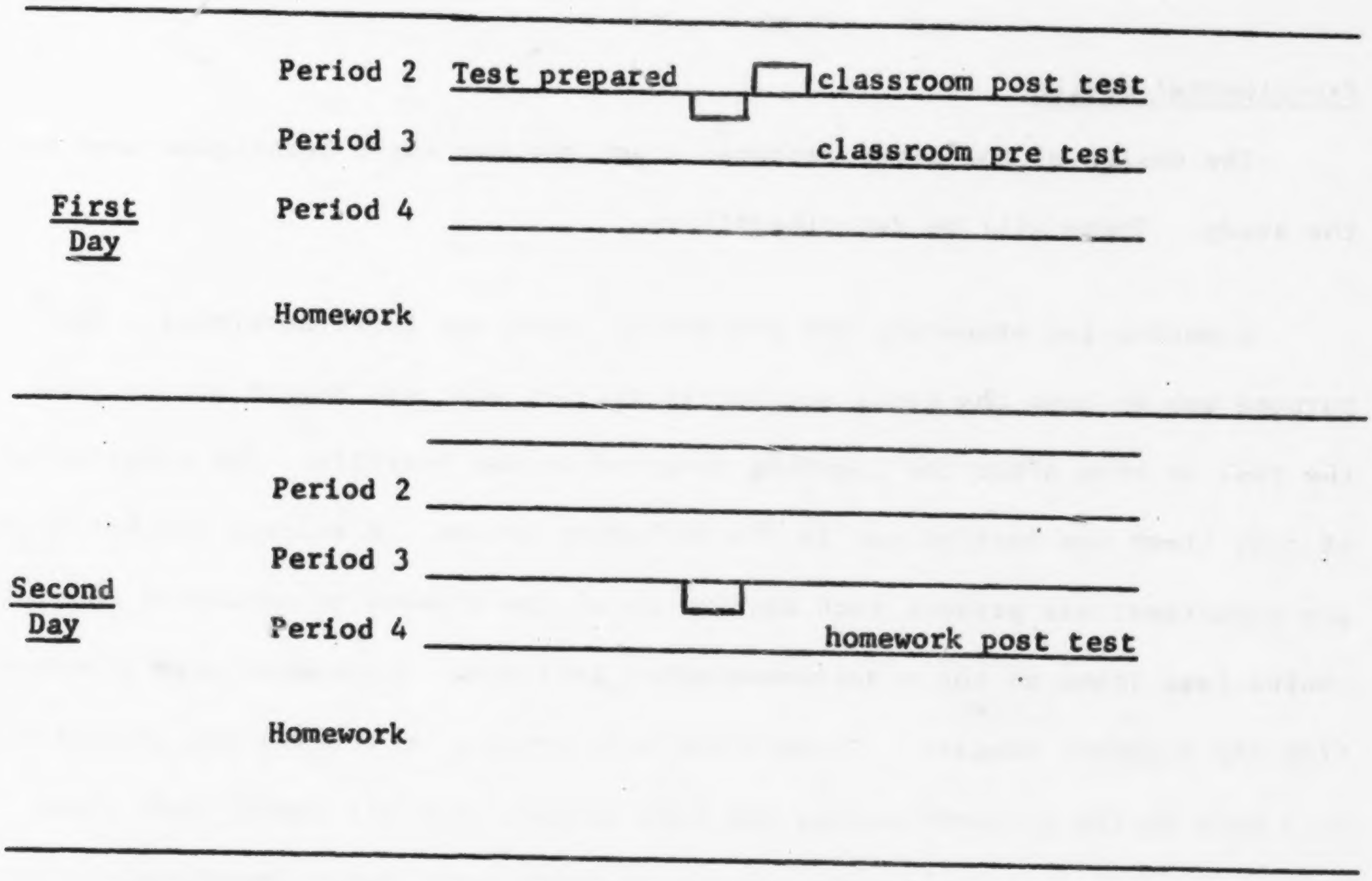
METHOD

Experimental design

The design of the study centered about the two basic techniques used in the study. These will be described first.

A method for preparing and presenting tests was first developed. The purpose was to have the tests accurately reflect what was taught and to give the test as soon after the learning occurred as was possible. The preparation of test items was carried out in the following manner. A science teacher from the department was present each day in one of the classes to construct multiple-choice test items as the classroom teacher lectured. Items were also prepared from the homework content. These items were printed on acetate and presented as a quiz to the students during the same period. In this manner test items corresponded to what was taught and the students were tested immediately after their learning.

The second novel feature of this study was the method of measuring learning without interfering with instruction and without letting students know what was to be learned as they would from a pre-test. The test was limited to ten minutes so as not to interfere to any great extent with class activities. It was necessary to measure level of knowledge on the topic before class sessions, after class sessions but before homework and finally after homework, which could only be measured the next day before the next class session. The three tests which were required should be identical. To prevent student familiarity with test items three matched groups were employed. One took the test after class, one before class and the third after homework. Table I shows the typical daily quiz pattern that permitted measurement of classroom learning, homework learning and total learning. This pattern was repeated for a period of a week.


Period 2
Test prepared
classroom post test
Period 3
classroom pre test
First Day
Period 4
Homework
Period 2
Period 3
Second Day
Period 4
homework post test
Homework

Classroom Learning = Period 2 score minus period 3 score

Homework Learning = Period 4 score minus period 2 score of previous day

Total Learning = Period 4 score minus period 3 score of previous day

Table I Typical daily quiz pattern to measure classroom learning, homework learning and total learning

Three ninth grade science classes were used for a week study of chemistry. The classes had 26, 24 and 21 students respectively. The three classes were taught by a single teacher during periods 2, 3 and 4.

Each class was given a pre-test before the study and the same test as a post test after the study. These tests consisted of 30 multiple choice and 40 true-false questions which were taken from facts presented in the textbook used by the students. A unit outline of material to be covered during the week of the study was obtained from the teacher, and the questions covered this material also.

Thirteen films and eighteen filmstrips on the unit on chemistry were secured and made available to the teacher for use in teaching the topic.

Analysis of data

An analysis of the data in this study is presented in tables II and III.

The analysis in table II deals with scores on the daily tests. For each day separately all cases available on that day are included, but in the five day total only cases for whom scores are available for all five days are used. The values in the F column show significant variation among group means. Further comparisons among the means are shown in the t columns. Values in these columns are calculated only where the F values were significant.

All the t values which compare the means of the period 2 group with the means of the period 3 group are significant, showing a real gain as a result of instruction.

TABLE II COMPARISONS AMONG MEAN SCORES ON DAILY TESTS FOR THREE GROUPS

Day	Period 3		Period 2		Period 4		F	t	t
	N	Mean	N	Mean	N	Mean	3 Periods	Period 2 -Period 3	Period 4 -Period 2
1st day	21	4.19	23	6.04	17	6.12	17.32**	5.16**	.21
2nd day	20	3.95	23	4.26	19	4.58	.70	--	--
3rd day	13	2.62	24	4.33	20	2.80	14.93**	4.51**	4.59**
4th day	20	5.95	22	11.55	19	10.16	34.79**	8.09**	1.98
5th day	18	8.22	23	10.00	20	10.40	4.52*	2.39*	1.55
Sum of 5 days***	13	26.15	19	37.42	15	33.87	14.86**	6.23**	1.88

* Significant at .05 level.

** Significant at .01 level.

*** Only students who had a test score for each of the five days are included here.

Among the t values which compare the period 4 group with the period 2 group only one is significant. This one significant difference occurred on the third day and it favored the period 2 group. The data indicate, therefore, that homework does not contribute to gain in learning.

The data in table III show considerable variation among both pre-test and post-test means. The variation among post-test means taken without regard to pre-test scores indicates some significance as shown by the F value of 2.49 which is significant at the .10 level. However, a covariance analysis with control on the pre-test scores yields a negligible value for F.

An appreciation of the difference between the two F values is gained from an examination of the adjusted means in table III. The adjustment was achieved by ascertaining the values of post-test means on condition that the pre-test means of the three groups were all equal to the mean of all three groups combined, or 63.15. Note that the adjusted means are very nearly equal. This explains the low value of F in the analysis of covariance which is really an analysis of the adjusted means.

Further insight may be gained from an analysis of the regression of post-test scores on pre-test scores, which shows that students with higher initial ability gained less than pupils with less ability. Consequently the low mean gain of the period 3 group can be explained by its high initial mean. Similarly the great gain of the period 2 group is a consequence of its low initial mean. The analysis of covariance corrects for these initial differences.

TABLE III COMPARISON OF POST-TEST MEANS AND COVARIANCE ADJUSTMENT FOR PRETEST SCORES

	N	Pretest	Post-Test	Adjusted Post-Test Means[**]
Period 3	13	Mean = 65.38	Mean = 67.15	Mean = 62.70
Period 2	19	Mean = 48.68	Mean = 59.47	Mean = 62.55
Period 4	15	Mean = 55.60	Mean = 64.33	Mean = 64.37
Analysis of Variance			F = 2.49[*] df: 2 , 44	
Analysis of Covariance				F = .186 df: 2 , 41

[*] Significant at .10 level but not at .05 level.

[**] Post-test means are adjusted to a common pretest mean of 63.15 for all groups, which is the pretest mean of all groups combined.

DISCUSSION

One of the important results of this study was the development of a technique for determining the source of learning in a unit of instruction. The results obtained are probably typical of only the type of instruction practiced by the teacher on this unit. The science teacher that made up the daily quizzes felt that the homework assigned was often irrelevant to the material studied in class. It was, at best, unmeaningful busywork, which was not taken seriously by the students in this particular experimental situation. The homework followed rather than preceeded the corresponding classwork. A slightly different design would have been required if homework preceeded classwork on a topic.

This study had too few subjects to draw meaningful results. It did give an insight into what was taught and how learning of this information might be measured.

This study reiterates the dominant role which forgetting and interference plays in the learning process. Studies in which learning is measured during the same period as the instruction are quite likely to show dramatic increases in learning. At the end of the unit or semester this learning would be very small or non-existent. The amount of retention of information that results from a school subject has probably not received the attention it deserves in studies of the educational operation.

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METHOD FOR INCREASING LEARNING UTILIZING LEARNING PROFILE FINDINGS

John G. Church
Sharon W. Miller
Robert M. Brown

The study reported herein was supported in part by grant No. 7-30-044.00 from the United States Office of Education, Department of Health, Education and Welfare.

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June 1964

Table of Contents

Page

FOREWORD 103

Summary Abstract 105

Purpose of Study 107

EXPERIMENTAL DESIGN 109
  Subjects 109
  Experimental treatment 109
  Test construction and testing 112

RESULTS 113
  Comparability of groups 113
  Daily quiz scores 113
  Unit post test scores 114

DISCUSSION 118

APPENDIX I - Teacher Interview 119

FOREWORD

This was the last of a series of studies whose purpose was to show how learning might be increased through use of the new educational media. The aim was to increase learning by a substantial amount rather than a few percentage points. This study suggests and partially demonstrates how this may be accomplished.

Appreciation is extended to the Shaker High School, Loudonville, New York, and especially to Richard McLaughlin, the science teacher who taught the lessons analyzed in the study. We would also like to thank the Junior-Senior High School of Voorheesville, New York for their assistance in providing a control group for the study.

Teachers, curriculum designers and research personnel should find this study of interest. It indicates how large increases in learning may be attained through the use of the new media and a new approach to presenting instructional material.

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METHOD FOR INCREASING LEARNING UTILIZING LEARNING PROFILE FINDINGS*

John G. Church
Sharon W. Miller
Robert M. Brown

Summary Abstract

Prior studies had shown that new media permitted the teaching of more material in less time. Usual testing methods have not measured the additional material taught with the new media. In many studies the time that has been saved has not been efficiently utilized. In this study the experimental group was taught much more material in an eight day period than the normal class group. When tested on this material the normal class group scored considerably lower. Learning gains by the experimental group were found to be 67% greater than that of the normal class group. Much of this increase could be attributed to the additional material covered by the experimental group. This study suggests that the new media are more useful in teaching a greater amount of material in a given time period than in teaching a specified amount better.

In the first of this series of studies[1] an analysis utilizing the learning profile technique indicated that some types of instruction using the new media were many times as effective as others. It also showed that a large part of class time was taken up with the ineffective procedures. Attempts to increase the scores on unit and semester tests were sometimes successful but the amount of increase was seldom in excess of ten per cent.

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*This research was supported in part by Grant No. 7-30-044.00 from the United States Office of Education, Department of Health, Education and Welfare. The principal investigator was Loran C. Twyford. John Church directed the study. Sharon W. Miller prepared test items during the lessons, arranged for visual materials and assisted in collection of data. Robert M. Brown helped in testing and analysis of data.

[1] New Media for Improvement of Science Instruction, Loran C. Twyford, John G. Church, Hildreth H. McAshan, Robert M. Brown, New York State Education Department, Albany, New York.

It became apparent that one way of increasing learning was to utilize the most effective media for a greater portion of the available time.

It was also discovered in another study[2] that a large part of learning may occur outside the classroom. When this is so, classroom activities may be covering material that has already been learned outside of class. Learning profile analysis suggested that much new information was not actually new but had been learned in previous courses. The ability of the new media to increase learning of material that is already known is necessarily limited. It was therefore felt to be a requirement of this study that content taught with the new media should not be previously known.

In order to demonstrate large increases in learning it is necessary to consider the matter of testing. The following formulae may be helpful in this discussion. The amount of learning may be measured by the number of facts, concepts or skills that are learned and the degree to which they are learned. This may be expressed by the formula:

(1) Amount of learning = Number of items x degree of learning

Equally important is the amount of time required to acquire that amount of learning. This gives a formula for rate of learning:

(2) $$\text{Rate of learning} = \frac{\text{number of items x degree of learning}}{\text{time}}$$

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[2] A Comparison of the Relative Effectiveness of Four Methods of Teaching Ninth Grade General Science. Ralph Smith and Hildreth H. McAshan. New York State Education Department, Albany, N.Y.

The more time that is required to learn a given number of items to a given degree the lower the rate of learning. Lower rates of learning result in less increase in knowledge over a given period of time.

The amount of time assigned to a topic is often fixed. If the number of items to be learned is also fixed,then the degree to which the items are learned is the major variable. There are certain practical limits to the degree to which an item may be learned. Many students will learn during the first presentation, a few more during the next presentation and finally additional presentations may not appear to make much difference. Because of this practical limit it is important to know the number of items that can be taught during the period rather than to extend all efforts toward perfect performance on a limited number of items.

As a result of a study of these relationships it was decided to measure all facts taught during the unit rather than the few that had normally been tested for. An alternative would have been to discover in how little time a given body of information could be learned to a certain degree of proficiency.

Purpose of study

The purpose of this study was to utilize the efficient instructional characteristics of the new media to teach a much larger body of information in a given amount of time. It was also desired to discover whether this larger body of information was learned as well as when the normal amount of information was taught.

Two hypotheses may be stated:

1. More information can be taught by using new media than is normally taught.

2. **Students will learn better those things they are taught with the new media.**

EXPERIMENTAL DESIGN

Subjects

The normal class and experimental groups were composed of ninth grade junior high school students in a suburban high school. A control group was located in another suburban high school. Each group consisted of approximately 30 students.

Experimental treatment

The study was concerned with instruction during six days on part of a ninth grade science unit. The topics covered included, pulleys, transfer of forces compound machines, engines, internal combustion and the power cycle. Table I describes the instruction in more detail.

Table I
Outline of Information Covered by Experimental and Control Groups

Day 1	Pulleys Single fixed pulley Single movable pulley Pulley systems
Day 2	Transfer of forces Belts Gears Chains
Day 3	Compound machines Auto brakes Auto transmission
Day 4	Steam engine
Day 5	Automobile engine Jets and rockets
Day 6	Diesel engine
Day 7	Review of entire unit
Day 8	Test on entire unit

In the normal class group the teacher planned his usual lesson. The content was left to his discretion and no attempt was made to change his plans. When this normal class lesson plan was somewhat complete, ways of presenting the same material (and more if possible) were planned for the experimental group using a variety of audio-visual equipment and materials.

Beside the chalkboard and charts that the teacher normally used, (Fig. 1) other equipment was used. It included a motion picture projector, filmstrip projector, overhead projector and tape recorder. More than a dozen different films were ordered and the teacher selected those thought to be appropriate. Transparent slides were prepared for the teacher and some were prepared by the teacher. A rear projector screen was used so that the teacher could control the projectors from the front of the room.

Both experimental and normal class groups were taught by the same teacher. The person was an effective teacher utilizing normal patterns of instruction. He was also thoroughly familiar with the operation of educational communications equipment.

The teacher was asked to apply a series of suggestions that had been developed by John Church in a previous study.[3] These suggestions had been subjectively arrived at through analysis of learning profiles in two year long studies. A list of these suggestions is included in Appendix I with some comments on them made by the teacher after the study.

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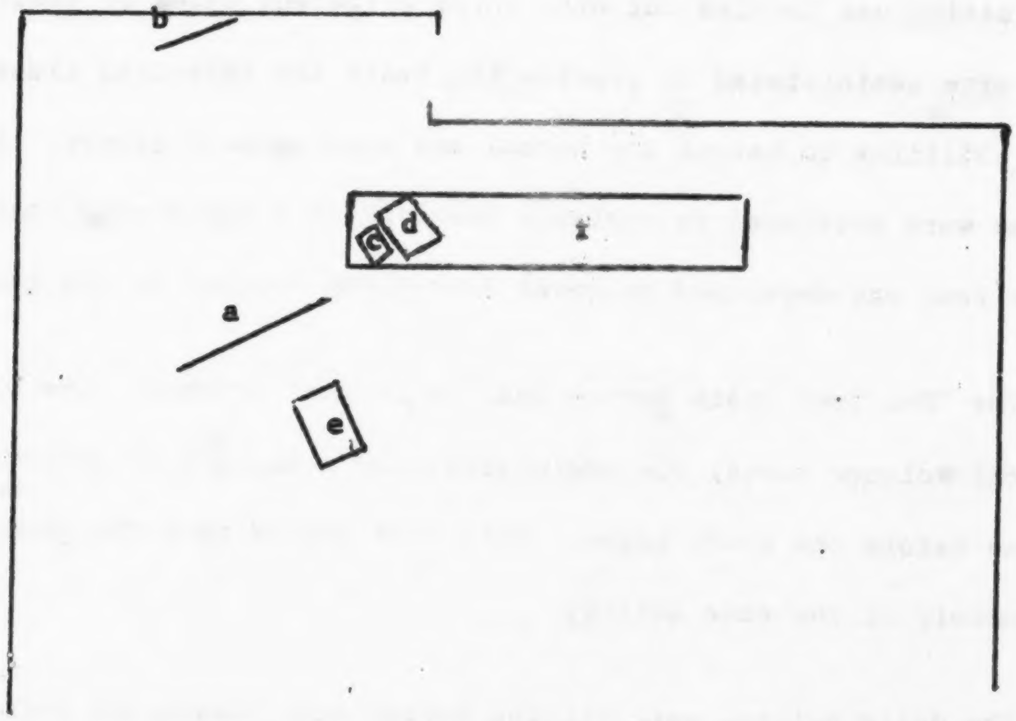
[3] "New Media for Improvement of Algebra Instruction", John G. Church, Robert M. Brown, Loran C. Twyford, New York State Education Department, Albany, New York, April 1964.



a - Rear projection screen
b - Mirror
c - Filmstrip-slide projector
d - Motion picture projector
e - Overhead projector
f - Demonstration counter

Figure 1 Location of Equipment in Classroom

Test construction and testing

Testing was carried out with three different types of tests. First, tests were administered to provide the basis for selecting classes with equal abilities to become the normal and experimental groups. Second, daily quizzes were developed to evaluate learning on a day-to-day basis. Third, a unit test was developed to cover everything learned by the groups.

The "New York State Survey Test in General Science" (the biological and physical science parts) was administered as a measure of ability in general science before the study began. This test showed that the groups were approximately of the same ability.

The daily quizzes were written during each lesson and were based on the actual content being taught. This method had previously been employed[4] to make test items to correspond closer to what was taught. The test was administered during the final ten minutes of the period and was projected on a screen utilizing an overhead projector.

A unit test was administered at the end of the unit. It consisted of 75 multiple choice items covering practically everything taught during the six days. There were many items concerning material covered only in the experimental class since this class covered more material than the control classes. This test was in contrast to unit tests used in other studies. It covered material studied by the control and experimental group rather than that of the control group alone.

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[4] "Development of a Method for Measuring Sources of Learning." Sharon W. Miller, Robert M. Brown, New York State Education Department, Albany 1, New York, May 1964.

RESULTS

Comparability of groups

The state survey test which was administered at the beginning of the study revealed that the normal class group had a slightly higher mean than the experimental group. Table II gives the results of this test and shows that the groups were approximately of the same ability.

Table II
Results of State Survey Test in General Science

Group	No. of students	Range of scores	Mean	Percentile
Normal	33	56 - 94	80.7	75
Experimental	28	60 - 89	76.1	65
Control	28	62 - 99	83.5	77.5

Additional test results were available to indicate the comparability of the experimental and normal groups. This consisted of 30 items covered in a prior unit's test. These items covered information that had been taught to each group by identical methods. The mean of correct answers by each group was 20.

Daily quiz scores

The daily quiz scores are shown in Table III. Since the number of questions varied from day to day, the scores are all given as percentage scores. No quiz was given on the third day. This was because of "student teacher day" in the school.

Table III

Daily Quiz Scores

Day	Normal Class		Experimental Class		Significant of Mean Difference (t)
	N	Mean	N	Mean	
1	31	56.2	29	77.3	5.41**
2	32	92.5	29	89.7	-1.19
3	--	--	--	--	--
4	33	62.4	26	67.9	1.62
5	31	61.2	25	73.9	2.93**
6	31	70.0	28	80.7	2.52*
Average		68.5		77.9	

*Significant at .05 level.
**Significant at .01 level.

The analysis in Table III shows that in four days out of the five the experimental class had a higher mean than the normal class. In three of the days the differences in favor of the experimental class were statistically significant. The data indicate superiority for the experimental method over the normal method. According to this comparison the experimental group did 14% better than the control group on these daily quizzes.

Unit post test scores

The unit test included 105 items. The study started after the unit on work and machines had begun. Therefore the teacher wished the unit test to include 30 questions on material covered in the first part of the unit. These questions are referred to as "pre-study content." The normal and experimental classes had identical means on this part of the test. (See Table IV).

Table IV

Means of Normal, Experimental and Control Classes on Final Tests and on State Science Survey Test

Test	Normal Class	Experimental Class	Control Class
Total Content (75 items)	47.6	54.9	34.9
Usual Content (40 items of total)	28.5	32.3	---
Pre-study Content (30 items)	20.3	20.3	---
State Survey	80.7	76.1	83.5

The part of the test directly involved in the study is referred to as "total content." These 75 items were made up from class notes, and so covered information that was taught during the study. The experimental group had a class mean of 54.9 (raw score) and the normal group had a mean of 47.6. Thus the experimental group had a 15 per cent higher class mean.

The learning gain for the normal class during the course of the study was obtained by subtracting the control mean from the normal class mean. This gave a gain score of 12.7 points. The gain score for the experimental group was 20 points which was 67 per cent greater than the normal class.

Of the items labeled "total content", 35 tested information that was covered only by the experimental group as a result of the greater amount of material that could be covered using the new media. The other 40 items called "usual content" were covered by both the normal and experimental classes. Comparing the class means of 32.3 and 28.5, the experimental group was better by 13%.

Table V

Comparison of Normal and Experimental Classes
by Analysis of Variance and Analysis of Covariance

(F ratios)

Test	Analysis of Variance	Analysis of Covariance*
Usual Content	.67 df: 1 , 59	3.04 df: 1 , 57
Pre-study Content	.23 df: 1 , 59	.02 df: 1 , 57
Total Content	4.62** df: 1 , 59	14.00*** df: 1 , 57

*Controlling on scores in State Survey Test.
**Significant at .05 level.
***Significant at .01 level.

Table VI

Comparison of Normal, Experimental and Control Groups on Test of Total Content (F ratios)

Analysis of Variance	Analysis of Covariance*
22.35	64.87
df: 2 , 82	df: 2 , 79

Table V shows a significant difference between experimental and normal classes in the test of total content only, suggesting that the experimental method is useful in teaching more information. The analysis of covariance is useful particularly in emphasizing the group difference by equalizing the effect of prior knowledge as measured by the state survey test.

As may be expected, the F ratios in table VI are especially high because of the very low means of the control class.

*controlling on scores in State Survey Test

DISCUSSION

The methods and results of this study differ markedly from those of previous studies. Within the limitations of confidence imposed by the size of the sample it was clear that an impressive increase in learning was obtained during a fixed period of time. This is the magnitude of increase that can result in greater use of the new media and significant advances in instructional methods.

The implications of this study for future research in media are important. Some new media permit learning of much more material in a given period of time. This increase may not be detected with tests normally used to measure course achievement. Since the new media seldom cover the same content previously covered in the course it is important to test for what the new media actually present.

This was the last study conducted under the grant from the U.S. Office of Education. It would certainly be desirable to repeat this study with larger groups of students. An earlier study by Smith[2] showed that a teacher could cover much more information in classroom lectures when required to do so. The teacher indicated that this was a very difficult and demanding task. It is important in subsequent studies that the control group teacher not compete with the media presentations but teach in a normal manner if the findings are to have meaning. It is also important that the teacher have a reasonable amount of familiarity with the new media and rely on them to provide the instruction.

APPENDIX I

Teacher Interview

The suggestions for improving learning were discussed with the teacher. A brief summary of his opinions follows each of the principles.

I. GENERAL TEACHING PROCEDURES

A. Go quickly to the point. Learning is low whether in films or in lectures.

The teacher agreed, generally. He felt that this was especially important in film utilization.

B. Present new information, or present any information which must be repeated in a new way.

The teacher agreed, within the limitations of the topic. He stressed that just because the demonstration is in the text is no reason to omit it as a classroom demonstration if it is a good one.

C. Bring some new media very early into the class presentation.

The teacher thought this would be effective if the media were properly selected. However, he felt that some things need explanations before they are shown.

D. Use a variety of educational media.

"Certainly."

E. Plan to cover more material.

The teacher agreed that more material (or greater detail) could be covered.

F. Use a rear projection screen and mirror to enable the classroom teacher to control all equipment and face the class.

The teacher felt that this statement was too specific, and should perhaps read: "Use any arrangement of equipment to allow the teacher to face the class." The rear projection screen could be recommended. The use of multiple screens might be preferable since rear projection screens are not as good for front projection. He also suggested the use of small screens.

II. MOTION PICTURES

A. See if a motion picture is available to cover key topics.

The teacher felt that films are excellent for presenting information, and that they can also emphasize attitudes and outlooks. He thought that the statement indicating that learning is not affected by whether the film is black and white or color should be explained since it "might upset some teachers."

B. Ask the students to look for answers to specific questions as they view a film.

The teacher thought this was a good idea.

C. Use the film more than once.

The teacher stated that if a film was good he would like to use it as an introduction and as a review. He felt that borrowing a film for a long enough time to do this would be a problem.

D. Skip general, introductory, dramatic, and historical sequences in films.

The teacher felt that some dramatic and historical scenes are good experiences, and that this suggestion shouldn't state that all such sequences should be omitted.

III. OVERHEAD PROJECTION

A. Plan the design and content of overhead transparencies yourself.

The teacher felt that some people just wouldn't know how to plan transparencies.

B. Present difficult points by simple, clear-cut steps.

The teacher thought that this is just a matter of educational psychology that should be followed no matter what media was used.

C. Save time by using the overhead for routine tasks.

The teacher agreed with this suggestion.

D. Give frequent quizzes which are to be considered in class grades.

The teacher agreed with the idea of utilizing more quizzes.

E. Use the overhead projector as a "group tutor device."

The teacher felt that this was a nice idea, but that it required too much time for a teacher to prepare.

IV. FILMSTRIPS

A. Select pertinent parts of a filmstrip.

The teacher wholeheartedly agreed with this. He suggested that filmstrips could even be cut into 2" x 2" slides.

B. Use the filmstrip as a part of the group tutor device.

The teacher thought that this could be done.

C. Make the filmstrip a part of the class.

The teacher thought that this depended upon the nature of the filmstrip.

V. RECORDINGS

A. Use disc recordings when appropriate and available.

The teacher felt that this was true of any media, and perhaps the wording should be changed to: Don't ignore the available disc recordings."

B. Tape record some presentations.

The teacher thought that this was good for regular classes, and suggested using a taped presentation as a substitute when the teacher had to be absent.

VI. OTHER COMMUNICATIONS MEDIA

A. Use a variety of media.

"Yes."

B. Make both content and communications media new to each student. Whenever....it is made novel through communications media, student learning will increase.

The teacher disagreed, stating that learning doesn't necessarily increase. He asked if novelty was measured. He then suggested a footnote to validate the idea of students measuring learning rather than novelty.